

PATENT ABSTRACTS OF JAPAN

(11) Publication number : 2003-013826

(43) Date of publication of application : 15.01.2003

(51) Int. Cl. F02M 69/04

F02B 31/00

F02B 31/02

F02D 9/02

F02F 1/42

F02M 51/02

F02M 69/00

(21) Application number : 2002-137163

(71) Applicant : HITACHI LTD

(22) Date of filing :

03.07.1992 (72) Inventor :

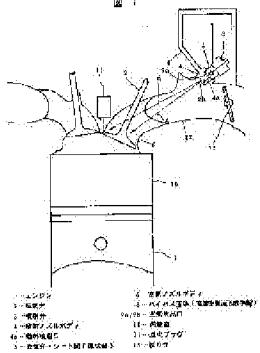
OSUGA MINORU

OYAMA TAKASHIGE

NOGI TOSHIJI

YAMAGUCHI JUNICHI

(54) FUEL SUPPLY DEVICE OF ENGINE



(57) Abstract:

PROBLEM TO BE SOLVED: To prevent fuel adhesion to a combustion chamber, to improve particulating of fuel, to improve forming of air-fuel mixture in the combustion chamber, and to increase combustion efficiency and exhaust emission control.

SOLUTION: An injection valve 3 is disposed in the downstream of a throttle valve 15 of an intake passage. Air in the upstream of the throttle valve is jetted from peripheries 9a and 9b of the injection port of the injection valve 3 using pressure difference from a passage 8 bypassing the upstream of the throttle valve 15. The high speed air flow jetted from the bypass passage 8 surrounds injected fuel and prevents diffusion of the fuel, and guides the fuel to a position near the center of the combustion chamber of the upper surface of the head of an intake valve 2 or a position near the center of the combustion chamber between the intake valve and a sheet 5. A high speed air flow forming means may be interchangeable with a pipe for guiding the fuel and air flow.

LEGAL STATUS

[Date of request for examination] 12.06.2002

[Date of sending the examiner's decision of rejection] 16.11.2004

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.

2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The fuel supply system of the engine characterized by having set up so that it may have a means to form high-speed airstream in an engine inhalation-of-air path at least in the fuel supply system equipped with the fuel injection valve at the time of low load driving and this high-speed airstream and the injection fuel of said fuel injection valve may arrive at the location of combustion chamber central approach , or the location of the combustion chamber central approach between an inlet valve and a sheet intensively , while on the top face of head of an engine inlet valve .

[Claim 2] In claim 1, said fuel injection valve is arranged on the throttle valve lower stream of a river of said inhalation-of-air path. Said high-speed airstream means forming Make the throttle valve of said inhalation-of-air path bypass, and the air of the throttle valve upstream at the bypass path which blows off from the perimeter of the injection tip of said fuel injection valve High-speed airstream which blows off from the bypass path (high-speed airstream) the differential pressure of a throttle valve vertical style -- being generated, surrounding the injection fuel of said fuel injection valve, and preventing diffusion of a fuel, so that this fuel may be led to the location of combustion chamber central approach, or the location of the combustion chamber central approach between an inlet valve and a sheet, while on the top face of head of said inlet valve The fuel supply system of the engine characterized by having set up.

[Claim 3] It has two or more fuel injection tips to which said engines are 2 inlet valves / cylinder mold, and said fuel injection valve was equivalent to two inlet valves in claim 1. The branching path corresponding to each inlet valve is formed in the location near the cylinder of said inhalation-of-air path. To one side of this branching path The swirl control valve (it abbreviates to SCV hereafter) by which closing motion control is carried out according to an engine load is prepared. And said high-speed airstream means forming Make the throttle valve of said inhalation-of-air path bypass, and the air of the throttle valve upstream at the bypass path which blows off from the perimeter of each injection tip of said fuel injection valve Making it deviate to the

direction which this high-speed airstream blowing off unifies the fuel injected from each fuel injection tip of said fuel injection valve, and does not have SCV among said branching paths The fuel supply system of the engine characterized by setting up and changing so that this fuel may be led to the location of combustion chamber central approach, or the location of the combustion chamber central approach between an inlet valve and a sheet with high-speed airstream, while on the top face of head of one of the two's inlet valve.

[Claim 4] It is the fuel supply system of the engine which two or more arrangement of the air port of said bypass path is carried out around the fuel injection tip of said fuel injection valve in claim 2 or claim 3, and is characterized by these air ports differing in a path.

[Claim 5] The fuel supply system of the engine characterized by having the lengthwise direction air-current means forming which makes the air current between engine inlet valve and sheet the flow of a lengthwise direction at least at the time of low load driving in the fuel supply system which equipped the engine inhalation-of-air path with the fuel injection valve.

[Claim 6] In claim 5, the path of the throttle valve lower stream of a river of said inhalation-of-air path branches to two. When the auxiliary valve by which closing motion control is carried out according to an engine load is prepared in one branching path among this branching path and this auxiliary valve is closed The branching path of the direction which does not have an auxiliary valve functions as said lengthwise direction air-current means forming. The fuel supply system of the engine characterized by having set up so that the air which passes through a branching path without this auxiliary valve may bypass said fuel injection valve and may form a lengthwise direction air current in the location of combustion chamber central approach locally among between engine inlet valve and sheet.

[Claim 7] It is the fuel supply system of the engine characterized by having two or more fuel injection tips to which said engines are 2 inlet valves / cylinder mold in claim 5, and said fuel injection valve was equivalent to two inlet valves, forming the branching path corresponding to each inlet valve in the location near the cylinder among said inhalation-of-air paths, and having established said lengthwise direction air-current means forming for said every branching path.

[Claim 8] While said engines are 2 inlet valves / cylinder mold, the branching path corresponding to each inlet valve is formed in the location near the cylinder among said inhalation-of-air paths in claim 5 and a fuel is injected by only one side of this branching path from said

fuel injection valve It is divided into two near the cylinder of the branching path by the side of [by which fuel injection is carried out] this up and down. The fuel supply system of the engine characterized by having set up so that the auxiliary valve by which closing motion control is carried out according to engine loaded condition may be prepared in a bottom path among beam paths at this rate and it may function considering a top path as said lengthwise direction air-current means forming.

[Claim 9] The fuel supply system of the engine with which an upper path is characterized by making it have functioned as said lengthwise direction air-current means forming when a path is divided up and down, the auxiliary valve by which closing motion control is carried out according to an engine load is prepared in that bottom path and this auxiliary valve closes a part of throttle valve lower stream of a river of said inhalation-of-air path in claim 5.

[Claim 10] It is the fuel supply system of the engine which prepares the supplementary air path which said fuel injection valve is arranged on the throttle valve lower stream of a river of said inhalation-of-air path, and introduces the supplementary air from the throttle valve upstream of said inhalation-of-air path in the fuel supply system which equipped the engine inhalation-of-air path with the fuel injection valve, and blows off near the engine inlet valve, and is characterized by to have set up said supplementary air path so that the air of a lengthwise direction air current may be blown off towards the location of combustion chamber central approach among between said inlet valve and its sheet.

[Claim 11] The fuel supply system of the engine characterized by arranging the idle control valve for controlling the cut valve or the idle rpm closed at the time of idle operation in said supplementary air path in claim 10.

[Claim 12] In the fuel supply system which equipped the engine inhalation-of-air path with the fuel injection valve, each engine cylinder has two inlet valves. The throttle valve lower stream of a river of said inhalation-of-air path branches to two corresponding to said inlet valve. When the auxiliary valve by which closing motion control is carried out according to engine load operational status is prepared in one side of this branching path and said auxiliary valve is open The fuel supply system of the engine characterized by having set up so that the injection fuel of said fuel injection valve may deviate to the direction without an auxiliary valve among said branching paths when the fuel from said fuel injection valve is injected towards the both

sides of said branching path and said auxiliary valve closes.

[Claim 13] The fuel supply system of the engine characterized by for each engine cylinder to have two inlet valves, and for the throttle valve lower stream of a river of said inhalation-of-air path to branch to two corresponding to said inlet valve in the fuel supply system which equipped the engine inhalation-of-air path with the fuel injection valve, and to make the air port of the bypass path which takes in the supplementary air from the throttle valve upstream of said inhalation-of-air path counter the end side of the septum of said branching path in the upper location near [said] the branching path, and to change.

[Claim 14] The fuel supply system of the engine characterized by connecting the pipe which leads the fuel injected to the location of combustion chamber central approach, or the location of the combustion chamber central approach between an inlet valve and a sheet while on the top face of head of an engine inlet valve to the injection tip of said fuel injection valve, and changing in the fuel supply system which equipped the engine inhalation-of-air path with the fuel injection valve.

[Claim 15] In the fuel supply system which equipped the engine inhalation-of-air path with the fuel injection valve, said fuel injection valve is arranged on the throttle valve lower stream of a river of said inhalation-of-air path. It has the bypass path which bypasses said throttle valve and blows off the air of the throttle valve upstream from the perimeter of an injection tip of said fuel injection valve. The pipe towards an engine inlet valve is connected to the injection tip of a fuel injection valve. And the include angle of this pipe The fuel supply system of the engine characterized by setting up and changing so that the injected fuel may be led to the location of combustion chamber central approach, or the location of the combustion chamber central approach between an inlet valve and a sheet with the air which blows off from said bypass path, while on the top face of head of an engine inlet valve.

[Claim 16] It is the fuel supply system of the engine characterized by for said pipe letting an injection fuel to the inside path, and having let the air from said bypass path pass to through and an outside path as duplex path structure in claim 15.

[Claim 17] It is the fuel supply system of the engine which said engine equips each cylinder with two inlet valves, and it branches near the cylinder to two, and SCV by which closing motion control is carried out according to engine loaded condition is prepared in one side of this branching path, and is characterized by introducing said pipe into the direction which does not have SCV among said branching paths among said

inhalation-of-air paths in claim 15 or claim 16 corresponding to this.

[Claim 18] In the fuel supply system which equipped the engine inhalation-of-air path with the fuel injection valve, each engine cylinder has two inlet valves. The throttle valve lower stream of a river of said inhalation-of-air path branches to two corresponding to said inlet valve. And it has the bypass path where said fuel injection valve is arranged [path] on the throttle valve lower stream of a river of said inhalation-of-air path, said throttle valve is bypassed, and the air of the throttle valve upstream blows off from the perimeter of an injection tip of said fuel injection valve. The fuel supply system of the engine characterized by connecting the pipe towards an engine inlet valve to the injection tip of a fuel injection valve, making the outlet of this pipe counter the upstream of the septum which branches said inhalation-of-air path with the end face of this septum in a near location, and changing.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the fuel supply system of the engine which equipped the inhalation-of-air path with the fuel injection valve.

[0002]

[Description of the Prior Art] the suction-port fuel injection equipment (fuel supply system) put in practical use more widely than before -- the gaseous mixture of 177 pages - 181 pages "gasoline engine of symposium [/ 8th internal combustion engine] lecture collected works ('90-1- 24, 25, Tokyo) -- it was what the injection fuel of a fuel injection valve

collides and adheres to the partial part of the cylinder wall which counters, evaporates gradually, and is conveyed by the swirl in a cylinder as indicated by research" about formation.

[0003] Moreover, so that it may be indicated by JP, 61-80365, U, JP, 1-76560, U, JP, 2-141678, U, JP, 2-141679, U, etc. So that it may be indicated by what the air from the throttle valve upstream was made to blow off around the nozzle of a fuel injection valve using the supplementary air path which bypassed the throttle valve, and attained fuel atomization to it, and JP, 61-16261, A and JP, 61-226563, A While making the injection fuel of a fuel injection valve collide with the inhalation-of-air path wall near a suction port Preparing the swirl path which makes the air from the throttle valve upstream blow off in a suction-port wall **** What prepared the pipe to which the air of the throttle valve upstream is led near the engine inlet valve is known so that it may be indicated by JP, 59-231133, A.

[0004]

[The technical problem which invention will solve and to carry out]
Although it is carried to the airstream at which most fuels collide with an inhalation-of-air path wall surface or an inlet valve, or an inlet valve turns by the way although various fuel supply systems are proposed from before as mentioned above, and collided with the combustion chamber wall surface of a cylinder, while it has been liquefied, according to such a method, it is easy to go into a combustion chamber, without the ability evaporating the part adhering to an inhalation-of-air path wall surface, an inlet valve, and a cylinder wall. Consequently, since the incomplete combustion of the fuel which is not evaporated is carried out and it is exhausted, it becomes an ununiformity, and the gaseous mixture which becomes the cause by which the amount of unburnt hydrocarbon increases, and is introduced into a combustion chamber forms a deep gas reservoir in the lower part, and becomes the cause of reducing combustion efficiency.

[0005] Therefore, conventionally, although the fuel which the inhalation-of-air line carried out fuel-injection timing of an injection valve before, and adhered to inhalation-of-air ***** an inlet valve, etc. is made to evaporate with heat, just this is not enough as evaporation of a liquefied fuel, and especially enough at the time of low-temperature starting. [just]

[0006] Although the approach of complicating the configuration of a piston conventionally, and giving turbulence to gaseous mixture and making gaseous mixture homogeneity according to the SUKYUSSHU effectiveness is indicated by the above-mentioned paper in order to cope

with such a problem, the configuration of a piston becomes complicated and the increase of surface area and heat loss tend to increase.

[0007] It is necessary to make the fuel of an injection valve detailed as other cures below at 10-micron meter. However, atomization of the fuel by the air current, the atomization by the supersonic wave, etc. can only process a little thing fuel, and since it has left the problem liquid-membrane-ized by adhering to a wall surface, an inlet valve, etc., they have not resulted until they raise sufficient effectiveness.

[0008] This invention is made in view of the above point, and the purpose solves the above-mentioned problem, makes confusion mind formation of a combustion chamber good, and is to offer combustion efficiency and the fuel supply system which can raise exhaust air purification.

[0009]

[Means for Solving the Problem] This invention proposes the following technical-problem solution means fundamentally, in order to attain the above-mentioned purpose.

[0010] (1) One has a means to form high-speed airstream in an engine inhalation-of-air path at least in the fuel supply system equipped with the fuel injection valve at the time of low load driving, and it proposes what was set up so that this high-speed airstream and the injection fuel of said fuel injection valve might arrive at the location of combustion chamber central approach, or the location of the combustion chamber central approach between an inlet valve and a sheet intensively, while on the top face of head of an engine inlet valve.

[0011] (2) Another proposes the thing equipped with the lengthwise direction air-current means forming which makes the air current between engine inlet valve and sheet the flow of a lengthwise direction at least at the time of low load driving in the fuel supply system which equipped the engine inhalation-of-air path with the fuel injection valve.

[0012] (3) Another connects a pipe to the injection tip of a fuel injection valve, and proposes what leads an injection fuel to the location of combustion chamber central approach, or the location of the combustion chamber central approach between an inlet valve and a sheet while on the top face of head of an engine inlet valve with this pipe.

[0013] In addition, although various means for improving the characteristics of mixing about 2 inlet valves / cylinder mold engine are also proposed, an example explains this.

[0014]

[Function] According to the technical-problem solution means of (1), even if it is at the partial-load-operation time, such as low loading,

high-speed airstream can be locally generated using high-speed airstream means forming. And for example, if an injection fuel is made to collide with an inlet valve at the front like an inhalation-of-air line, local liquid membrane will be formed in the combustion chamber central approach on the top face of head used as the collision location.

[0015] The adhesion fuel of a head is evaporated with heat by this condition, and fuel evaporation is promoted by the Venturi effect in case high-speed airstream passes an inlet valve, while the adhesion fuel which is not evaporated is blown away by the airstream of the high speed which aimed at the above-mentioned injection fuel collision, homotopic, or the location of the combustion chamber central approach between the inlet valve and sheet of that near and atomizing it.

[0016] And they are agitated from a center by the vortex generated in a glow room, are diffused around it, and form good gaseous mixture in the whole combustion chamber while they prevent the reattachment of the fuel to a cylinder wall (combustion chamber wall), since this evaporation fuel (a atomization fuel is included) and high-speed airstream go into the central approach of a combustion chamber.

[0017] moreover -- even if a fuel will be atomized according to the Venturi effect of the high-speed flow which passes an inlet valve and a fuel will moreover adhere in part between an inlet valve and a sheet, when an inlet valve opens if it lets a fuel and high-speed airstream pass in the location of combustion chamber central approach among between an inlet valve and a sheet even if it is the case where an inhalation-of-air line is made to inject a fuel by the way -- this -- high-speed airstream -- blowing away -- it atomizes. and a atomization fuel should enter in the center of a combustion chamber straight, and since it is agitated by the vortex produced by high-speed airstream at this time, the same operation as the above should do it -- good gaseous mixture -- formation is realized.

[0018] partial load operating range, such as low load driving with which the above-mentioned operation has the air rate of flow in an inhalation-of-air path in a low-speed condition, -- setting -- compulsory -- high-speed airstream -- forming -- good gaseous mixture -- since formation is promoted, it is especially effective. even if it does not borrow the force of the means which in high-speed load operation makes such high-speed air since the air current in an inhalation-of-air path is in a high-speed condition -- good gaseous mixture -- it can form.

[0019] In addition, formation of the high-speed airstream at the time of low load driving leads the air of the throttle valve upstream to a throttle valve lower stream of a river in the style of [of a throttle

valve] the upper and lower sides at a bypass path etc. using differential pressure, and is attained with devising the outlet of the bypass path, the direction of the air blowdown, etc.

[0020] According to the technical-problem solution means of (2), the air current between an inlet valve and a sheet becomes a lengthwise direction, a combustion chamber is made to generate a small lengthwise direction vortex unlike the flow (lateral flow) along the slope of the conventional inlet valve, and a atomization fuel rides on this minute eddy, and is spread from the center of a combustion chamber.

Consequently, wall surface adhesion can be prevented and uniform gaseous mixture is formed in a combustion chamber.

[0021] leading a atomization fuel in the center of a combustion chamber like an operation of (1), since according to the technical-problem solution means of (3) the fuel injected is led in the location of combustion chamber central approach among between combustion chamber central approach, or an inlet valve and a sheet, without spreading a fuel with a pipe while on the engine top face of an inlet valve -- adhesion of the fuel to a cylinder wall -- it can prevent -- good gaseous mixture -- formation can be aimed at.

[0022]

[Example] A drawing explains the example of this invention.

[0023] The 1st example of this invention is shown in drawing 1 - drawing 4 . This example is an example of claims 1 and 2.

[0024] An engine 1 is the usual gasoline engine. The fuel injection valve 3 is arranged two about an inlet valve in the throttle valve 15 down-stream location of the inhalation-of-air path 22. As for a fuel injection valve (it considers as an injection valve hereafter) 3, an electromagnetic injector is used. The fuel injection tips 4a and 4b of the nozzle body 4 of an injection valve 2 have turned to the central site of a combustion chamber 10, while on the top face of head of an inlet valve 2.

[0025] The air nozzle body 6 is formed in the surroundings of a nozzle body 4, and the nozzle holes 9a and 9b of the air nozzle body 6 are arranged in the tip periphery of the fuel injection tips 4a and 4b.

[0026] Nozzle holes 9a and 9b turn into an air port of the path 8 which made the throttle valve 15 of the inhalation-of-air path 22 bypass, and the inlet port of the bypass path 8 opens a course of them for the throttle valve 15 upstream.

[0027] The number of nozzle holes 9a and 9b is two, and the configuration, the include angle, and the location are set up so that it may arrive at the place (combustion chamber central approach near

[here] an ignition plug 11) where the fuel injected from an injection valve 3 was surrounded by the high-speed airstream which blows off from the air nozzle holes 9a and 9b in, and it separated from cylinder 10 wall while on the top face of head of an inlet valve 2 intensively.

High-speed airstream is produced when the differential pressure of a throttle valve vertical style like low load driving becomes large.

[0028] The jet from the air nozzle holes 9a and 9b is colliding aslant, and an ellipse-like jet's (airstream's) being compounded for the cross section, and changing the aperture of two nozzle holes 9a and 9b, a jet is deflected in the direction of broken-line B, and the injection fuel passing through the inside of this is also deflected in the direction of broken-line B. Nozzle holes 9a and 9b are designed so that this direction of deviation B may become among the annular sections (between an inlet valve 2 and its sheet) 5 the direction near the location 11 of combustion chamber 10 central approach, i. e., an ignition plug.

[0029] A fuel is made to blow off from an injection valve 3 in this example at the front like the inhalation-of-air line of an engine 1.

[0030] At the time of partial load operation, the fuel injected from the nozzle 4 goes into orbit of the direction of B, without being surrounded from nozzle holes 9a and 9b to an air blast, and being spread, and collides with the location near [as shown in drawing 2] the ignition plug 11 in the head top face of an inlet valve 2 locally. When an inlet valve 2 opens, as shown in drawing 3 , it is the high-speed airstream (at this time) from nozzle holes 9a and 9b. a fuel is injected from a nozzle 4 -- **** -- it passing through the location of combustion chamber central approach among the annular sections 5, and, while the fuel which adhered to the inlet valve 2 by this is blown away and atomized Evaporation promotion is carried out by the so-called Venturi effect attracted with negative pressure, it enters in the combustion chamber 10 center, and good gaseous mixture is formed in about 11 ignition plug.

[0031] According to this example, it can avoid that a fuel adheres to an inhalation-of-air tube wall, a cylinder wall, and a piston side, without spreading a fuel.

[0032] Moreover, as shown in E1 and E2 of drawing 3 , the air E which passes along an inlet valve 2 flows so that a fuel may be wrapped, a fuel rides the flow of E1, and is led in the center of a combustion chamber, and the reattachment to a cylinder wall is prevented.

[0033] Furthermore, since minute turbulence can be built in a combustion chamber 10 with the air of an air nozzle 6 as another effectiveness of this example and the atomization fuel is spread from the center of a

combustion chamber in this small vortex, homogeneity formation of gaseous mixture is promoted.

[0034] Next, if an engine load increases, the pressure of an inlet pipe 22 will increase, the rate of the jet B of nozzle holes 9a and 9b falls, and as A of drawing 4 shows, a fuel comes to be supplied to the annular section 5 at homogeneity. At this time, since the rate of E1 and E2 of the air which passes along an inlet valve 2 becomes large even if an air nozzle 6 does not form high-speed airstream, a fuel is re-atomized like D with inhalation air.

[0035] Next, drawing 5 and drawing 6 explain the 2nd example. The 2nd example is an example of claim 1, claim 2, and claim 3.

[0036] This example is the fuel supply system of the method which each cylinder 10 of an engine 1 has two inlet valves 2 and 21, and has two or more injection tips 4a and 4b to which the nozzle body 4 of a fuel injection valve 3 corresponded to two inlet valves.

[0037] Septum 22' is prepared in an about ten-cylinder location among the inhalation-of-air paths 22, the branching paths 22a and 22b corresponding to each inlet valves 2 and 21 are formed, and the swirl control valve (it abbreviates to SCV hereafter) 13 of this branching path by which closing motion control is carried out, corresponding to an engine load in 22a on the other hand is formed. This SCV13 serves as close at the time of open and low loading at the time of a heavy load.

[0038] On the other hand, a fuel injection valve 3 is located in the middle of the branching paths 22a and 22b on a throttle valve lower stream of a river, and arranges the air nozzle body 6 on the perimeter of the nozzle body 4 of an injection valve. The nozzle holes 9 and 91 are located in the perimeter of a tip of the fuel injection tips 4a and 4b, and the air nozzle body 6 injects the air of the throttle valve upstream from the air duct 8 which made the throttle valve of the inhalation-of-air path 22 bypass by nozzle holes 9 and 91. Nozzle holes 9 and 91 are set up so that the high-speed airstream (high-speed airstream is produced when the differential pressure of a throttle valve vertical style becomes large like [at the time of low load driving]) which makes direction 22b which is not among [SCV13] branching paths deflect the fuel injected from each injection tips 4a and 4b of a fuel injection valve 3 at the time of low load driving may blow off. If this makes nozzle holes 9 and 91 circular and it is made for the paths phi 2 of 91 to differ as the path phi 1 of a nozzle hole 9 ($\phi_1 > \phi_2$) It is the air blast which comes out of nozzle holes 9 and 91 colliding, and the jet of the shape of a *** ellipse shown by C of drawing 6 being formed, and changing paths phi1 and phi2 as mentioned above moreover. A

difference arises in the force of that air blast, it deviates like B of drawing 6 , the injection fuel from the injection valve nozzles 4a and 4b passing through the inside of this is also unified, and it is influenced by the above-mentioned air blast of a deviation.

[0039] Therefore, if the deviation direction B is set as the central approach of a combustion chamber 10 among the annular sections between inlet-valve 2 and a sheet as shown in C of drawing 5 , it will be guided intensively in the C region shown in drawing 5 of the inlet valve 2 of the correspondence, the fuel injected from the injection tips 4a and 4b of a fuel injection valve 3 being deflected by branching path 22b of the direction which does not have SCV13 by the high-speed airstream which blows off from air nozzles 9 and 91 at the time of low load driving. Therefore, the fuel injected from an injection valve 3 collides with the location C near the ignition plug 11 of the annular section 5 of an inlet valve 2, without being surrounded by this airstream and spread. And if an inlet valve 2 opens, the adhesion fuel of C location will be re-atomized by the air blast B like the operation stated also in the 1st example, and about 11 ignition plug of a combustion chamber 10 will be supplied.

[0040] Furthermore, at this example, at the time of low load driving, in a cylinder 11, a vortex occurs by the airstream from the branching path of one side, the whole is made to diffuse the detailed fuel with which this swirl enters in the center of a combustion chamber, and good gaseous mixture is formed because SCV13 closes.

[0041] If a load increases and it becomes heavy load operation, SCV13 will open. In this case, since the differential pressure of the vertical style of a throttle valve is in a small condition, the high-speed airstream from nozzle holes 9 and 91 does not arise, but the fuel injected separates, respectively, passes along the branching paths 22a and 22b, and collides with each inlet valves 21 and 22.

[0042] In this case, since the air rate of flow of the inhalation-of-air path 22 is quick, a fuel is atomized with the inhalation air which passes along inlet valves 2 and 21.

[0043] The structure of an injection valve 3 is shown in drawing 6 . The fuel injection tips 4a and 4b are formed in the nozzle body 4 of an injection valve 3. a valve 31 -- electromagnetism -- it can pull up according to the electromagnetic force of a coil. An injection valve 3 is attached in an inlet pipe 22 through a seal 23. The air nozzle body 6 is attached at the tip of a nozzle body 4, and the nozzle holes 91 and 92 are formed. Air is introduced into an air nozzle 6 from the throttle valve upstream through the bypass path 8 established in the inlet pipe

22.

[0044] According to this example, even if it is the engine of 2 inhalation-of-air valve specification per cylinder, the same effectiveness as the 1st example is acquired.

[0045] The fuel which is the fuel supply system of the engine of the conventional 2 inlet valves / 1-cylinder specification illustrated in order that drawing 7 might compare with the 1st example of the above and the 2nd example, and was injected from the injection valve 1 goes into a cylinder 10 through inlet valves 2 and 21. A fuel adheres to F1 of a cylinder wall, and the F2 section then. Moreover, it is the fuel supply system of the engine of 1 inlet valve / 1-cylinder specification illustrated in order that drawing 8 might compare with the 1st and 2nd example of the above, a branching path is formed in the location near the cylinder among inhalation-of-air paths, and SCV13' is prepared in one side of this branching path. In this case, when SCV13' is closed at the time of partial load operation and a fuel and inhalation air are introduced into the branching path of those without SCV13', the fuel injected from the injection valve 3 passes along an inlet valve 2, and adheres to the four Fcylinder 3 section.

[0046] In the fuel supply system of these drawing 7 and drawing 8, although a wall surface adhesion fuel gets heat from a wall and evaporates, in order not to move to the core of a cylinder and to make gaseous mixture into homogeneity by the swirl, powerful SUKYUSSH is required for it. Even if it produces a vertical swirl, it is difficult for fuel vapor to move to a core. In addition, although SCV13 is used also in the 2nd example, since a atomization fuel focuses in the center of a combustion chamber, it goes into it and this is spread around it from a center in this case, fault like drawing 8 is not produced.

[0047] That is, in order to solve the above problems, like the 1st and 2nd example, while on the top face of head of an inlet valve 2, an injection fuel is brought together in the location (location near an ignition plug) of combustion chamber central approach at the front like an inhalation-of-air line, and if this is re-atomized according to the Venturi effect by the high-speed airstream from an air nozzle, it can attain.

[0048] The fuel supply system of an engine another type [conventional] is shown in drawing 9 (a).

[0049] In this conventional example, although the fuel injected by the inhalation-of-air path 51 from the injection valve 50 is carried to the airstream at which it turns by the suction port of the inhalation-of-air path 52, there is airstream along the slope on the top face of head,

flow becomes a longitudinal direction, and the injection fuel which rides on this airstream collides with the combustion chamber wall surface 53, and forms liquid membrane 54. Consequently, it combusts incompletely, and liquid membrane is exhausted and becomes the cause by which the amount of unburnt hydrocarbon increases. Especially this problem is produced in a partial-load-operation region.

[0050] In order to prevent this, as shown in drawing 9 (b), form a fuel injection valve 50 in the throttle valve lower stream of a river of the inhalation-of-air path 51, and also A means 57, for example, a supplementary air path, to form high-speed airstream in about 52 engine inlet valve at the time of low load driving is arranged (about the example of the means forming of high-speed airstream). It is attained by setting up the blow-off include angle which is mentioned later and from which the supplementary air from which the outlet of this supplementary air path 57 blows off serves as flow of a lengthwise direction in the passage location of an inlet valve 52.

[0051] Since a fuel can be put on the high-speed airstream 56 from the auxiliary inhalation-of-air path 57, gaseous mixture can be formed in a combustion chamber center section and a fuel will not collide with the combustion chamber wall surface 53 even if it is at the partial-load-operation time if it does in this way, fuel adhesion is lost, combustion efficiency is made good, and the amount of the unburnt hydrocarbon under exhaust air is reduced sharply.

[0052] An example (the 3rd example) for making drawing 10 realize the principle of drawing 9 (b) is shown. This example is an example of claim 5 and claim 6.

[0053] A fuel injection valve 60 is arranged at the throttle valve 67 downstream of the inhalation-of-air path 69, this example divides the path of throttle valve 67 lower stream of a river into the main air duct 66 and the supplementary air path 63 up and down among the inhalation-of-air paths 69, and the auxiliary valve 64 is formed in the main air duct 66 used as a bottom path. An auxiliary valve 64 is controlled to close using an actuator at the time of low load driving, or it is made to be interlocked with a throttle valve 67. The outlet of the supplementary air path (top path) 63 is set up so that air may be blown off towards the location of the central approach of a combustion chamber 68 among the head peripheries of an inlet valve 61. It is made to be injected to combustion chamber central approach among the heads of an inlet valve 61 in the injection fuel by the injection valve 60.

[0054] 67 hopes that there is no bypass 67, in order to bypass a throttle valve 67, to introduce the air of the throttle valve upstream

into the nozzle of an injection valve 60, to make an injection fuel atomize and to do the following effectiveness so.

[0055] In the above-mentioned configuration, an auxiliary valve 64 is closed at the time of partial load operation. Since the air which flows on throttle valve 67 lower stream of a river is led to the supplementary air path 63 which extracted opening area by this, the air rate of flow increases and high-speed airstream is formed.

[0056] The fuel injected from the injection valve 60 collides with the combustion chamber central site on an inlet valve 61. The airstream 62 from the supplementary air path 63 is supplied so that this injected fuel may be exactly hit on an inlet valve 61. When an auxiliary valve 64 is closed, a great portion of air inhaled by the engine flows the supplementary air path 63. Thereby, the airstream 65 of a lengthwise direction is formed in a combustion chamber. Since a fuel rides on an air current and is intensively supplied to a combustion chamber central site, without gaseous mixture going to a longitudinal direction by this eddy, adhesion on a wall surface can be prevented.

[0057] Moreover, since the auxiliary valve 64 is closed, airstream does not hit a fuel 66, but the spraying direction is not bent but goes straight on in the location aimed at on the inlet valve 61.

[0058] At the time of full open operation, an auxiliary valve 64 is opened and air is inhaled without inhalation-of-air resistance by the engine.

[0059] Drawing 11 is what applied the principle of the example of drawing 10 to the engine of 2 inlet valves / cylinder mold (the 4th example), and is the example of claim 7.

[0060] It has two or more fuel injection tips to which the fuel injection valve 73 was equivalent to two inlet valves, and the branching paths 76a and 76b corresponding to inlet valves 70 and 70 are formed in the location near the cylinder among the inhalation-of-air paths 76.

[0061] The branching path is divided into Maine passage 76a' (76b') and supplementary air path (lengthwise direction air-current means forming) 76a" (76b"), respectively. Closing motion control of Maine style furnace 76a' and 76b' is carried out by the auxiliary valve 71. Although the fuel is atomized also here by the airstream supplied from the air duct 75 which bypassed the throttle valve 74, you may be the injection valve of the direction which does not have a bypass 75. It may be made for an auxiliary valve 71 to be interlocked with a throttle valve 74, and it may be driven with a negative pressure diaphragm so that it may open at the time of low loading and may operate with the negative pressure of an inlet pipe 76.

[0062] Drawing 12 is also the application (the 5th example) of drawing 10, and is the example of claim 8.

[0063] This examples of an engine are also 2 inlet valves / cylinder mold, the branching paths 84a and 84b corresponding to each inlet valve 80 are formed in an about 85-cylinder location among the inhalation-of-air paths 84, and it is made to be injected from the fuel injection valve 81 only to one side 84b of this branching path in the fuel. It is drawing seen from width, it is divided into two near the cylinder of branching path 84b up and down, and the auxiliary valve 82 by which closing motion control is carried out according to engine loaded condition is formed in a bottom path among beam paths at this rate, and drawing 12 (b) is set up so that it may function considering the top path 83 as lengthwise direction air-current means forming.

[0064] In this example, from one inlet valve, the gaseous mixture of a fuel and air is supplied and only air is supplied from another inlet valve. If it does in this way, it is [cloth / in a combustion chamber 85 / mixed / temper] deep in a certain part, and a certain part can be made thin, it is made to burn in thin gaseous mixture, and lean burn mode can be obtained in the whole combustion chamber.

[0065] Moreover, if an auxiliary valve 82 is closed at the time of partial load operation, it passes along the path 83 of an upper half, and air will serve as flow of a lengthwise direction, will flow in the combustion chamber 85 center of an inlet valve 80, and will form a longitudinal vortex. Gaseous mixture is agitated by this eddy and mixed temper cloth serves as homogeneity.

[0066] The 6th example is shown in drawing 13 and it is the example of claim 9. This example divides a path up and down for a part of throttle valve 104 lower stream of a river of the inhalation-of-air path 107 of 1 inlet valve / cylinder, and an auxiliary valve 103 is formed in that bottom path 107b, and when this auxiliary valve 103 closes, it is made for upper path 107b to have functioned as the same lengthwise direction air-current means forming as the 5th example. 105 is a bypass for fuel atomization which leads air to the point of an injection valve 106.

[0067] According to this example, the air of the flow of a lengthwise direction flows into the combustion chamber center section of the inlet valve 89, the vortex of a lengthwise direction is generated in the center of a combustion chamber, a combustion chamber is well agitated in it, and good gaseous mixture is formed in it because air flows to path 107b in the upper half of an inlet pipe when an auxiliary valve 103 is closed.

[0068] The 7th example is shown in drawing 14. This example is an

example of claim 10.

[0069] Although a fuel injection valve 95 is arranged also for this example at the throttle valve 91 downstream of the inhalation-of-air path 96, it is formed in the form where the supplementary air path 90 in which the auxiliary valve is not prepared bypassed the throttle valve 91. The air (supplementary air) from the throttle valve upstream introduced from the supplementary air path 90 blows off to about 94 inlet valve, and has formed the airstream of a lengthwise direction towards the location of combustion chamber central approach among between an inlet valve 94 and its sheet.

[0070] For this reason, when a throttle valve 91 is except full open (at the time of partial load operation), air flows through the supplementary air path 90, and high-speed airstream spouts from the blowdown hole 93. This airstream is injected so that it may collide with the combustion chamber central site of an inlet valve 94. For this reason, a minute eddy is formed in the center section of the combustion chamber. Gaseous mixture is agitated by this eddy and the mixed temper cloth of a combustion chamber becomes homogeneity.

[0071] Moreover, in this example, the cut valve 95 closed at the time of idle operation may be formed in the supplementary air path 90. It is because a rotational frequency will increase and fuel consumption will worsen at the time of idle operation, if the supplementary air is passed since there are few demand air contents.

[0072] In order to raise precision furthermore, as shown in the 8th example of drawing 15 , it is good to use a control valve (solenoid valve) 124 for the supplementary air path 90. 125 is the control unit of a solenoid valve 124.

[0073] An example of the timing diagram of the control action of a solenoid valve 124 is shown in drawing 16 . (b) shows the condition of the inhalation of air of a certain gas column. In this inhalation-of-air condition, a solenoid valve 124 is opened like (b), the supplementary air is supplied, and a minute vortex is formed in a combustion chamber. If the inhalation-of-air line is passing the supplementary air at the time of except, since the fuel which remained near the inlet valve will blow up to the upstream of an inlet pipe, this can be prevented if the above solenoid-valve control is performed.

[0074] Moreover, inspired air volume will increase at the time of idle operation etc., and a rotational frequency will increase it.

[0075] (Ha) shows like the inhalation-of-air line of another gas column. Corresponding to this, a solenoid valve 124 is operated like (d).

[0076] The modification (the 9th example) of the 8th example is shown in

drawing 17 . The distributor 126 was formed instead of the solenoid valve 124 of drawing 16 . A distributor 126 supplies the supplementary air to the paths 127a, 127b, 127c, and 127d corresponding to each gas column. When each gas column is like [inhalation-of-air line], the timing to supply constitutes a distributor 126 so that air may flow. [0077] The motor which it is a rotating type, and 128 is that driving source, for example, may drive with an engine crank, and rotates synchronizing with rotation of an engine is sufficient as this distributor 126. The same actuation as the 8th example is possible also for such a configuration.

[0078] Moreover, it may replace with the solenoid valve of the 8th example of the above, and opening control of the supplementary air path may be carried out by the idle roll control unit using the solenoid valve in which continuous control is possible.

[0079] Drawing 18 is the 10th example of this invention, and is the example of claim 12.

[0080] As for this example, each engine cylinder has two inlet valves 109a and 109b, the throttle valve lower stream of a river of the inhalation-of-air path 107 branches to two corresponding to an inlet valve, and, on the other hand, the auxiliary valve 108 of this branching path by which closing motion control is carried out according to engine load operational status is formed in 107a. An auxiliary valve 108 is closed at the time of partial load operation, and is opened at the time of full open load operation.

[0081] As shown in drawing 18 (a), when a fuel is equally injected towards the both sides of the branching paths 107a and 107b when the auxiliary valve 108 is open and nothing [auxiliary valve / 108] closes, the fuel injection valve 110 is set up so that a fuel may be deflected and injected to path 107b without an auxiliary valve, as shown in drawing 18 (b).

[0082] The configuration at the tip of an injection valve of drawing 18 was shown in drawing 19 . Drawing 19 (a) is in the condition which supplies the fuel to one inlet valve, when having closed the auxiliary valve. The orbit of a fuel is deflected by applying the high-speed airstream which 113 is the blowdown path of the bypass path to which air is led for example, from the throttle valve upstream, and is spouted from this path 113 to the fuel immediately after the injection from the measuring orifice 112. This deflecting angle is path 107a of drawing 18 .

[0083] Drawing 19 (b) shows the condition of having stopped the airstream from an air duct 113. A fuel is spouted straightly, without bending. This is performed when the auxiliary valve 107 of drawing 18

opens.

[0084] according to this example, when an auxiliary valve 107 is closed, inhalation of air is supplied only from one path 107a, a big eddy is formed in a combustion chamber, and churning of air and a fuel is promoted -- making -- gaseous mixture -- formation is made good. When the auxiliary valve 107 has closed, it prevents that an injection fuel adheres to this.

[0085] The fragmentary sectional view of the 11th example and its plan, and drawing 21 are drawings which saw this example from another direction, and drawing 20 is the example of claim 13.

[0086] Engines are 2 inlet valves / cylinder mold, and this example has branched to two corresponding to inlet valves 100a and 100b in throttle valve 99 lower stream of a river of the inhalation-of-air path 96. Bypass path 96a takes in the supplementary air from the throttle valve 99 upstream of the inhalation-of-air path 96, and blows off on a throttle valve lower stream of a river. Air port 96a' of bypass path 96a is made to have countered the end side of the bridge wall 97 of a branching path in the upper location near the branching path. Moreover, the fuel injection valve 98 is arranged for the upstream very near air port 96a' on the septum 97 and the production of air port 96a'.

[0087] The airstream supplied from bypass path 96a is spouted so that it may collide with the end face of a septum 97. A minute eddy will be formed in a combustion chamber center section if it does in this way. The fuel which blew off from the injection valve 98 is distributed to a combustion chamber, being in this eddy and being spread, and the mixed temper cloth of a combustion chamber becomes homogeneity. In this case, this with it better [to have made it seldom inject a fuel in the outside 101 of inlet valves 100a and 100b] (when a fuel is supplied outside, it is because a fuel disperses in the wall of a combustion chamber and an adhesion fuel is generated.) can be attained with the directivity of spraying of an injection valve 98.

[0088] Drawing 22 (a) shows the 12th example and is the example of claim 14.

[0089] This example connects a pipe 116 to the injection tip of a fuel injection valve 115, and it was made to lead the fuel injected to the location of combustion chamber central approach among between engine inlet valves 117 and sheets through a pipe 116. If it does in this way, an injection fuel will arrive at the location gone straight on and aimed at, without the air current of an inlet pipe 118 passing.

[0090] Also in this example, it can prevent that an injection fuel adheres to a combustion chamber wall.

[0091] Drawing 22 (b) is the modification (the 13th example) of the 12th example, and is the example of claim 15. A fuel injection valve 122 is arranged on throttle valve 121 lower stream of a river, and the air of the throttle valve upstream introduced from the path 120 which bypasses a throttle valve 121 blows off from the perimeter of an injection tip of a fuel injection valve 121. The pipe 119 towards an engine inlet valve is connected to the injection tip of a fuel injection valve 122, and the include angle of a pipe 119 is set up so that the injected fuel may be led to the location of combustion chamber central approach among between engine inlet-valve 117 and sheet with the air which blows off from the bypass path 120.

[0092] Even when according to this example the same effectiveness as the 12th example is done so and also an inhalation-of-air line performs fuel injection more by the way, by the airstream which blows off through the bypass path 120 and a pipe 119 the minute eddy 65 is formed in a combustion chamber, and the fuel injected by this airstream from an injection valve 122 atomizes -- having -- gaseous mixture -- formation can be further made into fitness and, moreover, the responsibility of fuel control can be raised by the fuel supply at the time as an inhalation-of-air line.

[0093] Drawing 23 is the modification (the 14th example) of the 13th example, and, as for a different point from the 13th example, an inhalation-of-air line makes a fuel-injection stroke a front.

[0094] According to this example, the injection fuel which collided with the inlet valve 117 through the pipe 119 is atomized by the inlet valve 117 by the airstream which blows off through a pipe 119. Also in this case, a fuel carries out opening of the pipe 119 to the combustion chamber central approach on an inlet valve.

[0095] Drawing 24 is an example which shows the connection structure of the above-mentioned pipe 119 and an injection valve 122, and the air from the bypass path 120 is supplied to the chamber 123 prepared in the lower part of an injection valve 122. From here, it is supplied in a pipe 119 through a hole 124. Within a pipe 119, as an injection fuel is wrapped in air, it blows off from the edge 125 of a pipe, without colliding with a pipe wall.

[0096] Drawing 25 is other examples of the above-mentioned pipe 119, and as pipe 119 duplex path structure, it lets an injection fuel pass to the inside path 119b, and they has let the air from the bypass path 120 pass to through and outside path 119a.

[0097] Inside path 119b of a pipe 119 is made into the pressure and this level of an inlet pipe 118 through the free passage way 127. The air

which blows off from outside path 119a through opening 119a' collides with a fuel 126, and is atomized. When there is no free passage way 127, 119in pipe b becomes negative pressure with an injection fuel, and a fuel adheres to a breadth pipe wall. If the free passage way 127 is formed, the pressure within [118] inhalation of air and the pressure of 119in pipe b become equal, and breadth prevention ***** of a fuel can plan fuel antisticking.

[0098] Drawing 26 is the 15th example of this invention, and is the example of claim 17 and claim 18 in the modification of the 12th - the 14th example.

[0099] This example is what was applied to the engine of 2 inlet valves / cylinder mold, on the other hand, SCV108 of the branching path corresponding to inlet-valve 117a by which closing motion control is carried out according to engine loaded condition is formed in 118a, and the pipe 119 is introduced into direction 118b which does not have SCV among branching paths. A pipe 119 supplies a fuel only to one inlet-valve 117b, and has supplied it to the location of the combustion chamber central approach of inlet-valve 117b.

[0100] If it does in this way, a fuel will come to be distributed centering on a combustion chamber, and its ignitionability of an ignition plug 131 will improve. Moreover, if the suction port of branching path 118a is closed by SCV108, a swirl will be formed in a combustion chamber and formation of gaseous mixture and combustion will be promoted.

[0101] In the modification (the 16th example) of the 15th example, focusing on the head of inlet-valve 117b, as for drawing 27 , opening of the fuel is carried out, as for the pipe 119 so that it may be supplied. Gaseous mixture can be distributed over the core of a combustion chamber even if such.

[0102] Drawing 28 is the modification of the dual structure pipe 119, it forms the wedge mold member 135 in the edge of a pipe 119, and it sets it up so that an injection fuel may collide here. Furthermore, atomization of a fuel is attained so that the air injected by the wedge mold member 135 from outside path 119a may hit. The example (the 17th example) which used the pipe 119 of drawing 28 for drawing 29 was shown. A fuel is divided in the two directions by the wedge member 135, and is distributed to each inlet valves 117a and 117b.

[0103] Other examples of the dual structure pipe 119 are shown in drawing 30 . When blowing off from edge 119a', the air which passed along outside path 119a of a pipe 119 determines the direction of air port 119a' so that it may collide on an inlet valve 117 and in the

clearance between inlet-valve 117 and a sheet 136. If it does in this way, a fuel can flow into a direct combustion chamber, and the air spouted from a pipe 119 will form the minute turbulent flow 137 in a combustion chamber, and it is not only used for the atomization of a fuel, but will promote mixing of a fuel. Furthermore, combustion is promoted by this turbulent flow.

[0104]

[Effect of the Invention] since a atomization fuel can be supplied to a combustion chamber as mentioned above according to this invention, preventing fuel adhesion on a combustion chamber wall surface -- the gaseous mixture of a combustion chamber -- formation can be made good and combustion efficiency and exhaust air purification can be raised.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The block diagram showing the 1st example of this invention

[Drawing 2] The explanatory view showing the fuel adhesion condition of the inlet valve after the fuel injection of the 1st example

[Drawing 3] The explanatory view showing actuation of the 1st example

[Drawing 4] The explanatory view showing actuation of the 1st example

[Drawing 5] The explanatory view showing the 2nd example of this invention

[Drawing 6] The sectional view showing the nozzle section of the injection valve used for the 2nd example

[Drawing 7] The explanatory view having shown the trouble of the conventional example

[Drawing 8] The explanatory view having shown the trouble of the conventional example

[Drawing 9] For (a), (b) is the explanatory view showing the trouble of the conventional example, and the explanatory view showing the principle of this invention.

[Drawing 10] The explanatory view showing the 3rd example of this invention

[Drawing 11] The explanatory view showing the 4th example of this invention

[Drawing 12] The explanatory view showing the 5th example of this invention

[Drawing 13] The explanatory view showing the 6th example of this invention

[Drawing 14] The explanatory view showing the 7th example of this invention

[Drawing 15] The explanatory view showing the 8th example of this invention

[Drawing 16] The timing diagram which shows the operating state of the 8th example

[Drawing 17] The explanatory view showing the 9th example of this invention

[Drawing 18] The explanatory view showing the 10th example of this invention

[Drawing 19] The explanatory view showing the nozzle section of the injection valve used for the 10th example

[Drawing 20] The explanatory view showing the 11th example of this invention

[Drawing 21] Drawing seen from another include angle of the 11th example

[Drawing 22] It is the explanatory view in which (a) shows the 12th example of this invention, and (b) shows the 13th example.

[Drawing 23] The explanatory view showing the 14th example of this invention

[Drawing 24] The explanatory view showing an example of the injection valve and pipe which are used for the 13th and 14th example

[Drawing 25] The explanatory view showing other examples of the above-mentioned pipe

[Drawing 26] the explanatory view
 showing the 15th example of this invention -- [Drawing 27] The explanatory view showing the 16th example of this invention

[Drawing 28] The explanatory view showing other examples of the above-mentioned pipe

[Drawing 29] The explanatory view showing the 17th example of this invention

[Drawing 30] The explanatory view showing other examples of the above-mentioned pipe

[Description of Notations]

1 [-- Injection nozzle body,] -- 2 An engine, 21 -- An inlet valve, 3 -- An injection valve, 4 4a -- A fuel injection tip, 5 -- Between an inlet valve and a sheet (annular section), 6 -- Air nozzle body, 8 -- A bypass path (high-speed airstream means forming), 9a, 9b -- Air port, 9 91 [-- SCV, 15 / -- A throttle valve, 22' / -- A bridge wall, 22a, 22b / -- A branching path, 57 / -- A bypass path (lengthwise direction air-current means forming), 119 / -- Pipe.] -- An air port, 10 -- A combustion chamber, 11 -- An ignition plug, 13

[Translation done.]

* NOTICES *

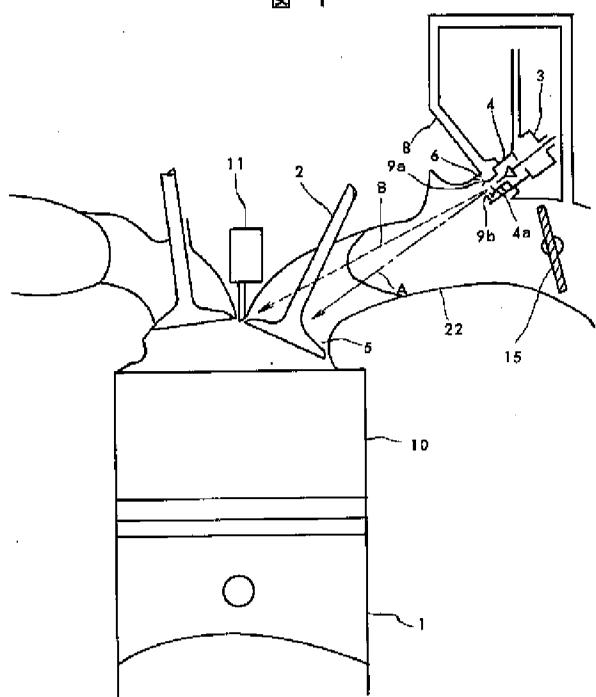
JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]

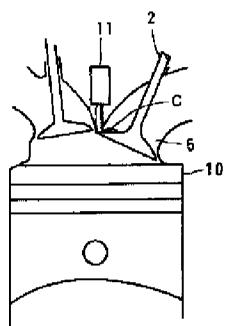
1



1 …エンジン	6 …空気ノズルボディ
2 …吸気弁	8 …バイパス通路 (高速空気流形成手段)
3 …噴射弁	9a, 9b …空気吹出口
4 …噴射ノズルボディ	10 …燃焼室
4a …燃料噴射口	11 …点火プラグ
5 …吸気弁、シート間 (環状部)	15 …較り弁

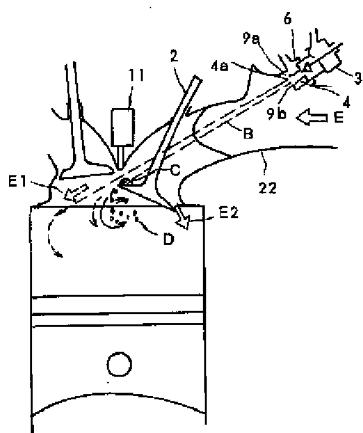
[Drawing 2]

图 2



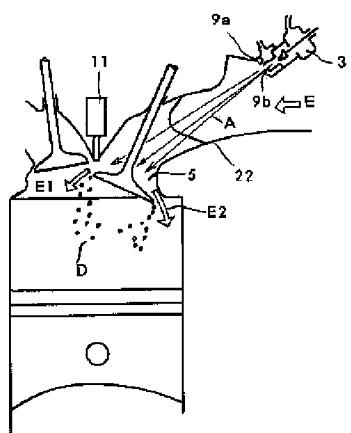
[Drawing 3]

図 3



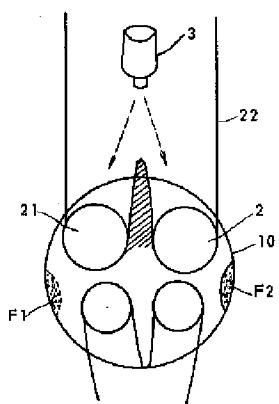
[Drawing 4]

図 4



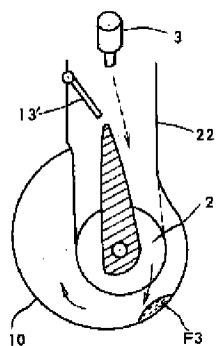
[Drawing 7]

図 7



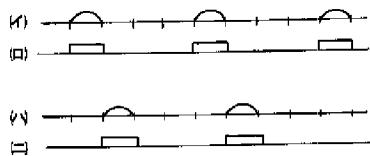
[Drawing 8]

図 8



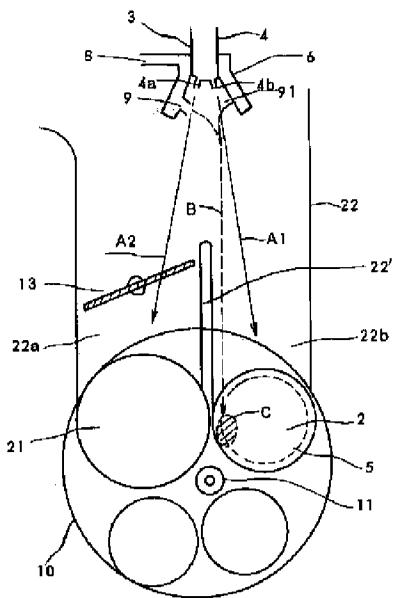
[Drawing 16]

図 16



[Drawing 5]

図 5



4a, 4b … 空気吹出口

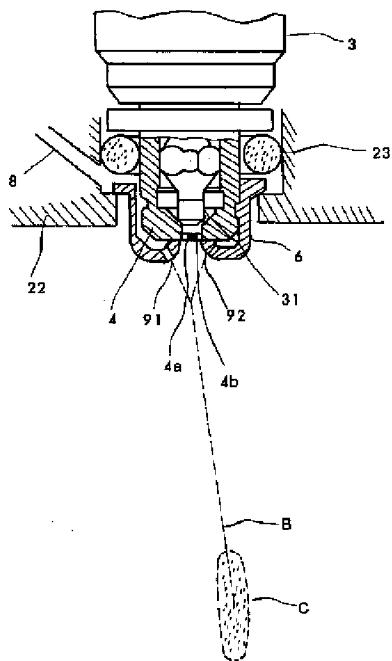
13 … S C V

22' … 隔壁

22a, 22b … 分岐通路

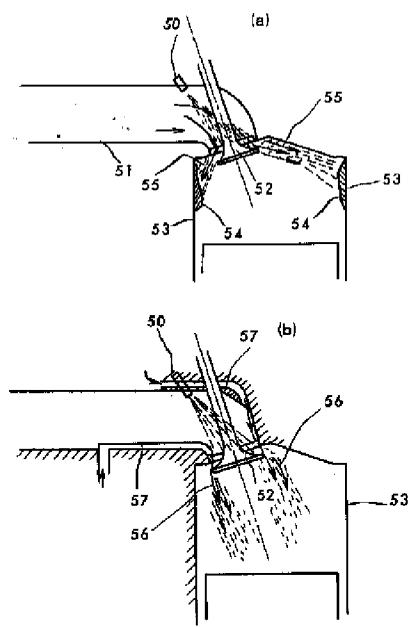
[Drawing 6]

図 6



[Drawing 9]

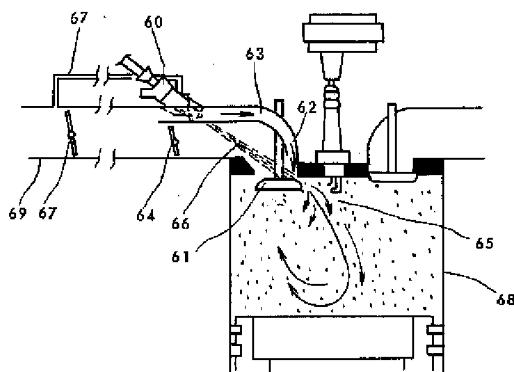
図 9



57 …バイパス通路（横方向気流形成手段）

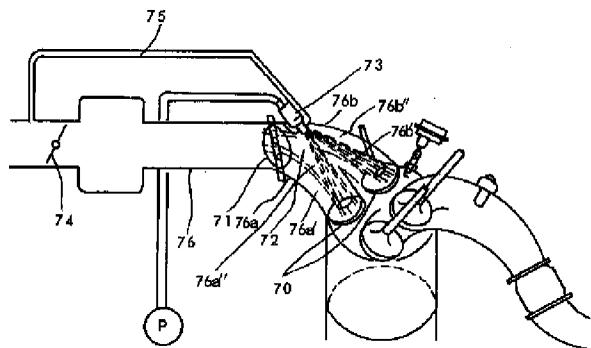
[Drawing 10]

図 10



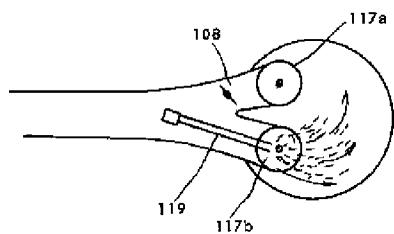
[Drawing 11]

図 11



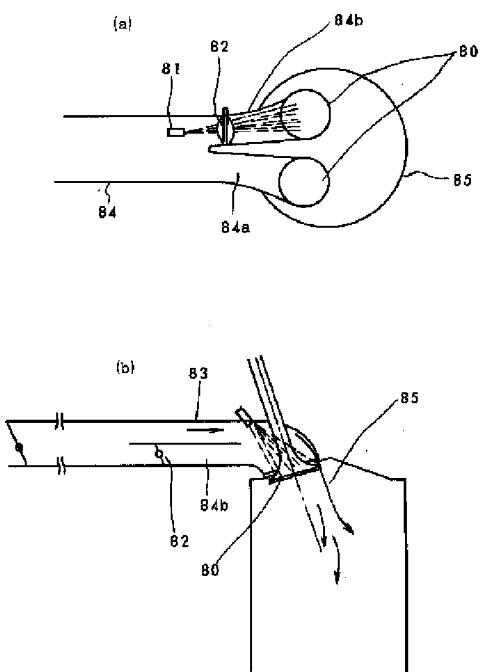
[Drawing 27]

図 27

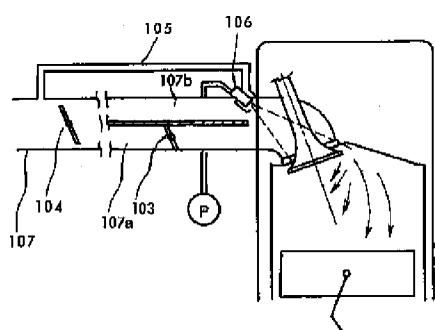


[Drawing 12]

図 12

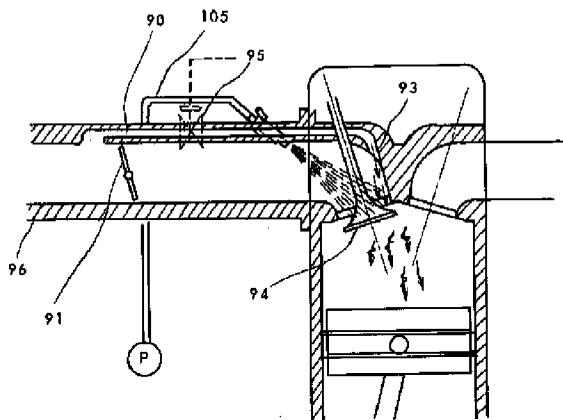


[Drawing 13]
図 13



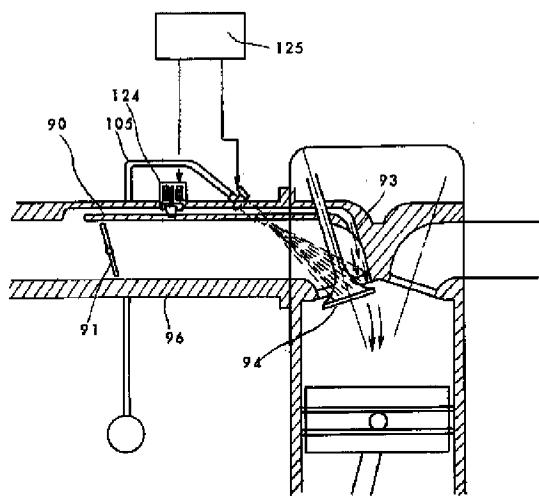
[Drawing 14]

図 14



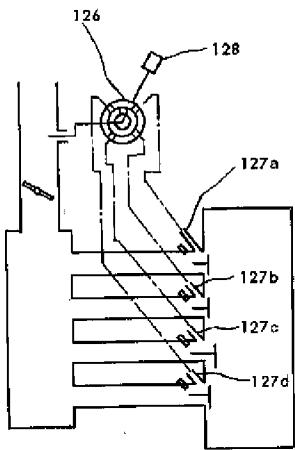
[Drawing 15]

図 15

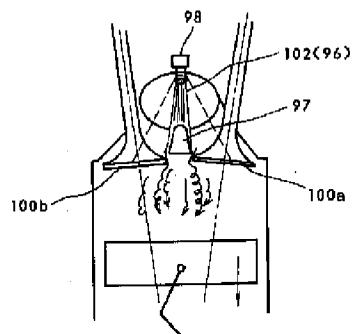


[Drawing 17]

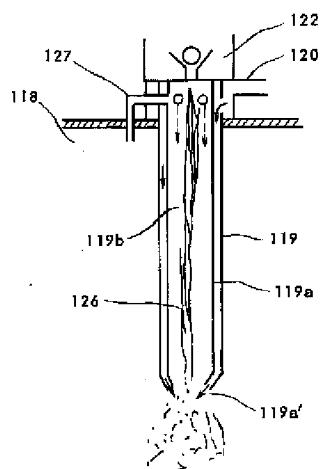
図 17



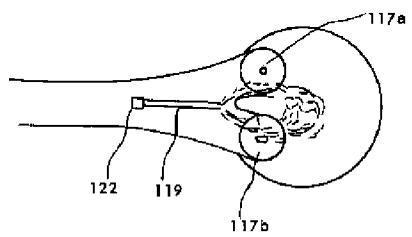
[Drawing 21]
図 21



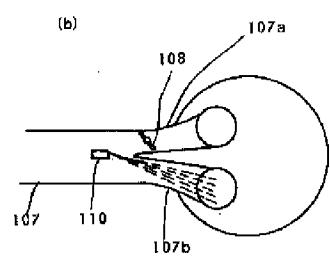
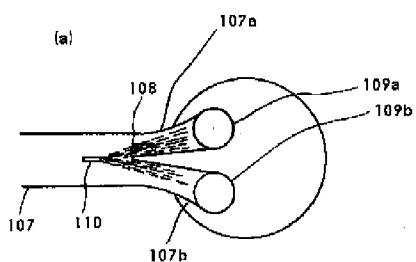
[Drawing 25]
図 25



[Drawing 29]
図 29

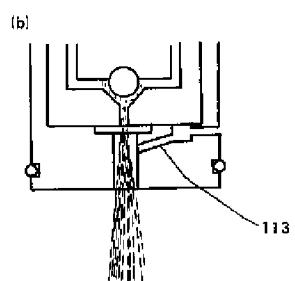
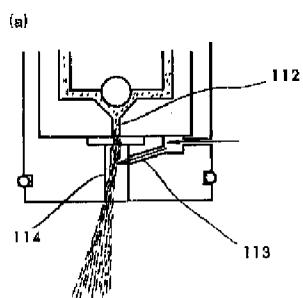


[Drawing 18]
図 18



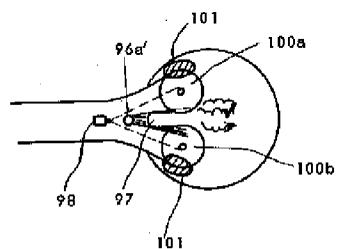
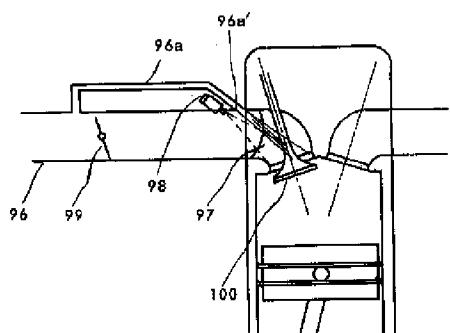
[Drawing 19]

図 19



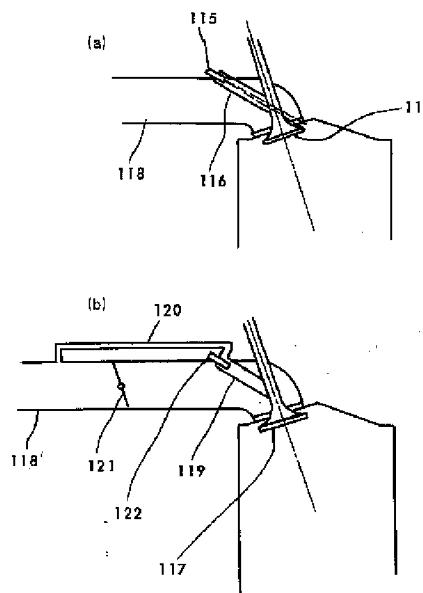
[Drawing 20]

図 20



[Drawing 22]

図 22



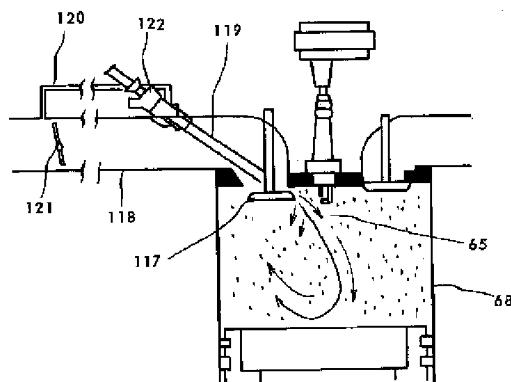
115 … 燃料噴射弁

117 … 吸気弁

119 … パイプ

[Drawing 23]

図 23



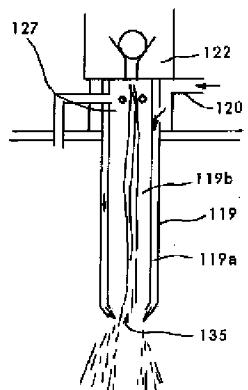
117 … 吸気弁

119 … パイプ

122 … 燃料噴射弁

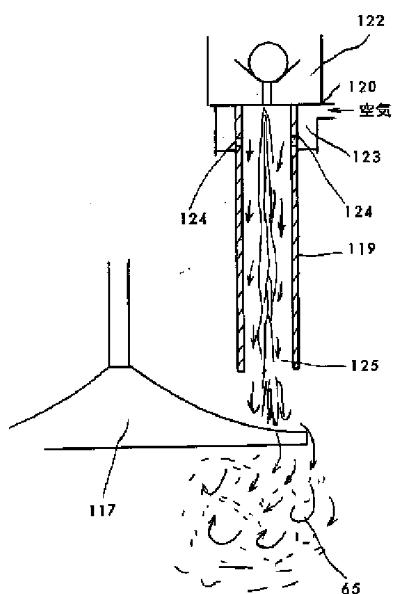
[Drawing 28]

図 28



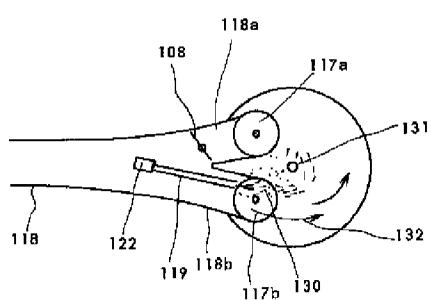
[Drawing 24]

図 24



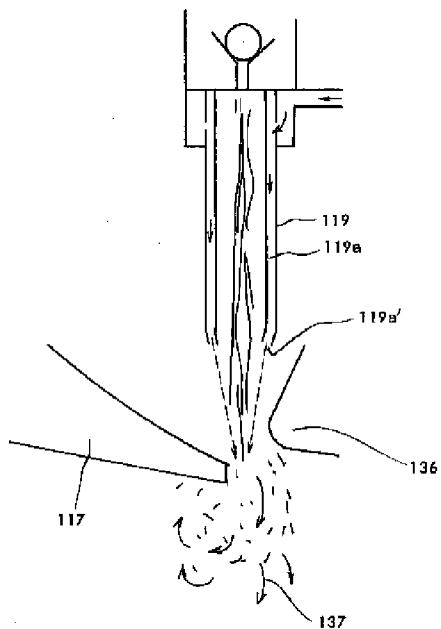
[Drawing 26]

図 26



[Drawing 30]

■ 30



[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

WRITTEN AMENDMENT

----- [a procedure revision]

[Filing Date] June 12, Heisei 14 (2002. 6. 12)

[Procedure amendment 1]

[Document to be Amended] Specification

[Item(s) to be Amended] Claim

[Method of Amendment] Modification

[Proposed Amendment]

[Claim(s)]

[Claim 1] In the fuel supply system which equipped the engine inhalation-of-air path with the fuel injection valve, the path section between the throttle valve of said inhalation-of-air path and a suction port is divided up and down. An auxiliary valve is prepared in the path of the bottom of them. Said fuel injection valve The fuel supply system characterized by considering as the configuration which is prepared so that it may be attached in the upper part of said inhalation-of-air path and fuel injection may be carried out towards the inlet valve of an engine cylinder, bypasses said throttle valve around the injection tip of this fuel injection valve, and draws the air of the throttle valve upstream.

[Claim 2] It is the fuel supply system according to claim 1 with which control to be set up so that the outlet of an upper path may blow off air towards [among the head peripheries of said inlet valve] the location of the central approach of said engine cylinder among said inhalation-of-air paths divided up and down, to make it injected to combustion chamber central approach by said fuel injection valve among the heads of said inlet valve in the injection fuel, and to close said auxiliary valve at the time of low load driving, or it is made for the throttle valve to be interlocked with.

[Procedure amendment 2]

[Document to be Amended] Specification

[Item(s) to be Amended] 0012

[Method of Amendment] Modification

[Proposed Amendment]

[0012] Furthermore, it sets as a desirable mode of the above (1) and (2) to the fuel supply system which equipped the engine inhalation-of-air path with the fuel injection valve. The path section between the throttle valve of said inhalation-of-air path and a suction port is divided up and down, and an auxiliary valve is prepared in the path of the bottom of them. Said fuel injection valve It is prepared so that it may be attached in the upper part of said inhalation-of-air path and fuel injection may be carried out towards the inlet valve of an engine cylinder, and what was considered as the configuration which bypasses said throttle valve and leads the air of the throttle valve upstream to the surroundings of the injection tip of this fuel injection valve is proposed. Moreover, the thing controls to be set up so that the outlet of an upper path may blow off air towards [among the head peripheries

of said inlet valve] the location of the central approach of said engine cylinder among said inhalation-of-air paths divided up and down, to make it injected to combustion chamber central approach by said fuel injection valve among the heads of said inlet valve in the injection fuel, and to close said auxiliary valve at the time of low load driving, or it was made to be interlocked with a throttle valve is proposed.

[Procedure amendment 3]

[Document to be Amended] Specification

[Item(s) to be Amended] 0021

[Method of Amendment] Deletion

[Translation done.]

(19)日本国特許庁 (JP)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開2003-13826

(P2003-13826A)

(43)公開日 平成15年1月15日 (2003.1.15)

(51)Int.Cl.⁷

F 02 M 69/04

識別記号

F I

テ-マコ-ト⁸(参考)

F 02 B 31/00
31/02

3 0 1

F 02 M 69/04

F 02 B 31/00
31/02

P 3 G 0 2 4
C 3 G 0 6 5
Q 3 G 0 6 6

審査請求 有 請求項の数 2 O L (全 15 頁) 最終頁に続く

(21)出願番号 特願2002-137163(P2002-137163)

(62)分割の表示 特願平4-176652の分割

(22)出願日 平成4年7月3日(1992.7.3)

(71)出願人 000005108

株式会社日立製作所

東京都千代田区神田講河台四丁目6番地

(72)発明者 大須賀 稔

茨城県日立市久慈町4026番地 株式会社日立製作所日立研究所内

(72)発明者 大山 宜茂

茨城県日立市久慈町4026番地 株式会社日立製作所日立研究所内

(74)代理人 100068504

弁理士 小川 勝男 (外1名)

最終頁に続く

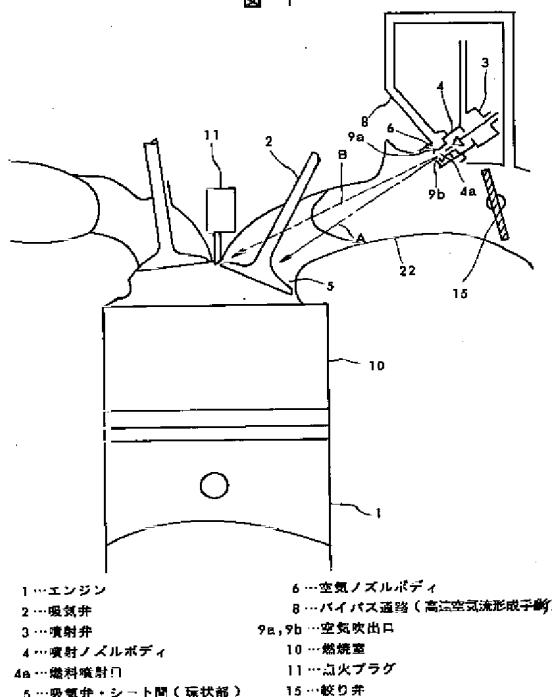
(54)【発明の名称】 エンジンの燃料供給装置

(57)【要約】

【課題】 燃焼室への燃料付着を防止しつつ、燃料微粒化向上を図って、燃焼室の混合気形成を良好にし、燃焼効率、排気浄化を高める。

【解決手段】 噴射弁3が吸気通路の絞り弁15下流に配置される。絞り弁15上流をバイパスする通路8から差圧を利用して絞り弁上流の空気を噴射弁3の噴射口の周囲9a, 9bから吹き出す。バイパス通路8から吹き出す高速空気流が噴射燃料を囲んで燃料の拡散を防止しつつ該燃料を吸気弁2のヘッド上面のうち燃焼室中央寄りの位置或いは吸気弁・シート間5の燃焼室中央寄りに位置に導く。高速空気流形成手段は燃料及び空気流を案内させるパイプであってもよい。

図 1



【特許請求の範囲】

【請求項1】 エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、少なくとも低負荷運転時に高速空気流を形成する手段を有し、この高速空気流及び前記燃料噴射弁の噴射燃料がエンジンの吸気弁のヘッド上面のうち燃焼室中央寄りの位置或いは吸気弁・シート間の燃焼室中央寄りの位置に集中的に到達するよう設定してあることを特徴とするエンジンの燃料供給装置。

【請求項2】 請求項1において、前記燃料噴射弁が前記吸気通路の絞り弁下流に配置され、前記高速空気流形成手段は、前記吸気通路の絞り弁をバイパスさせて絞り弁上流の空気を前記燃料噴射弁の噴射口の周囲から吹き出すバイパス通路で、そのバイパス通路から吹き出す高速空気流（高速空気流は、絞り弁上下流の圧力差により生じる）が前記燃料噴射弁の噴射燃料を囲んで燃料の拡散を防止しつつ該燃料を前記吸気弁のヘッド上面のうち燃焼室中央寄りの位置或いは吸気弁・シート間の燃焼室中央寄りの位置に導くよう設定してあることを特徴とするエンジンの燃料供給装置。

【請求項3】 請求項1において、前記エンジンは2吸気弁／シリンダ型で、前記燃料噴射弁が2吸気弁に対応した複数の燃料噴射口を有し、前記吸気通路のシリンダ近くの位置に各吸気弁に対応する分岐通路が形成され、この分岐通路の一方には、エンジンの負荷に応じて開閉制御されるスワールコントロール弁（以下、SCVと略する）が設けてあり、且つ、前記高速空気流形成手段は、前記吸気通路の絞り弁をバイパスさせて絞り弁上流の空気を前記燃料噴射弁の各噴射口の周囲から吹き出すバイパス通路で、この吹き出される高速空気流が前記燃料噴射弁の各燃料噴射口から噴射される燃料を一本化して前記分岐通路のうちSCVの無い方に偏向させつつ、該燃料を高速空気流と共に片方の吸気弁のヘッド上面のうち燃焼室中央寄りの位置或いは吸気弁・シート間の燃焼室中央寄りの位置に導くよう設定してあることを特徴とするエンジンの燃料供給装置。

【請求項4】 請求項2又は請求項3において、前記バイパス通路の空気吹出口は、前記燃料噴射弁の燃料噴射口の周囲に複数配置され、これらの空気吹出口が径を異にしていることを特徴とするエンジンの燃料供給装置。

【請求項5】 エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、少なくとも低負荷運転時にエンジンの吸気弁・シート間の気流を縦方向の流れにする縦方向気流形成手段を備えたことを特徴とするエンジンの燃料供給装置。

【請求項6】 請求項5において、前記吸気通路の絞り弁下流の通路が2つに分岐され、この分岐通路のうち、一方の分岐通路にエンジンの負荷に応じて開閉制御される補助弁が設けてあり、該補助弁を閉じた時には、補助弁が無い方の分岐通路が前記縦方向気流形成手段として機能し、この補助弁無しの分岐通路を通過する空気が前

記燃料噴射弁を迂回してエンジンの吸気弁・シート間のうち燃焼室中央寄りの位置に局部的に縦方向気流を形成するよう設定してあることを特徴とするエンジンの燃料供給装置。

【請求項7】 請求項5において、前記エンジンは2吸気弁／シリンダ型で、前記燃料噴射弁が2吸気弁に対応した複数の燃料噴射口を有し、前記吸気通路のうちシリンダ近くの位置に各吸気弁に対応する分岐通路が形成され、前記縦方向気流形成手段が、前記分岐通路ごとに設けてあることを特徴とするエンジンの燃料供給装置。

【請求項8】 請求項5において、前記エンジンは2吸気弁／シリンダ型で、前記吸気通路のうちシリンダ近くの位置に各吸気弁に対応する分岐通路が形成され、この分岐通路の一方にのみ前記燃料噴射弁から燃料が噴射されると共に、この燃料噴射される側の分岐通路のシリンダ近くが上下に二つに分けられ、この分けた通路のうち下側通路にエンジンの負荷状態に応じて開閉制御される補助弁が設けられ、上側通路を前記縦方向気流形成手段として機能するよう設定してあることを特徴とするエンジンの燃料供給装置。

【請求項9】 請求項5において、前記吸気通路の絞り弁下流の一部を上下に通路を分けて、その下側通路にエンジンの負荷に応じて開閉制御される補助弁が設けてあり、この補助弁が閉じた時に上側の通路が前記縦方向気流形成手段として機能するようにしてあることを特徴とするエンジンの燃料供給装置。

【請求項10】 エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、前記燃料噴射弁が前記吸気通路の絞り弁下流に配置され、且つ前記吸気通路の絞り弁上流から補助空気を導入してエンジンの吸気弁近くに吹き出す補助空気通路を設け、前記補助空気通路は、前記吸気弁とそのシート間のうち燃焼室中央寄りの位置に向けて縦方向気流の空気を吹き出すよう設定してあることを特徴とするエンジンの燃料供給装置。

【請求項11】 請求項10において、前記補助空気通路には、アイドル運転時に閉じるカット弁或いはアイドル回転数を制御するためのアイドル制御弁が配置されていることを特徴とするエンジンの燃料供給装置。

【請求項12】 エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、エンジンの各シリンダが2個の吸気弁を有し、前記吸気通路の絞り弁下流が前記吸気弁に対応して二つに分岐され、この分岐通路の一方にエンジンの負荷運転状態に応じて開閉制御される補助弁が設けてあり、前記補助弁が開いている時には、前記分岐通路の双方に向けて前記燃料噴射弁からの燃料が噴射され、前記補助弁が閉じる時には、前記燃料噴射弁の噴射燃料が前記分岐通路のうち補助弁無しの方に偏向するよう設定してあることを特徴とするエンジンの燃料供給装置。

【請求項13】 エンジンの吸気通路に燃料噴射弁を備

えた燃料供給装置において、エンジンの各シリンダが2個の吸気弁を有し、前記吸気通路の絞り弁下流が前記吸気弁に対応して二つに分岐され、且つ、前記吸気通路の絞り弁上流から補助空気を取り入れるバイパス通路の空気吹出口を、前記分岐通路近くの上流位置で前記分岐通路の隔壁の一端面に対向させて成ることを特徴とするエンジンの燃料供給装置。

【請求項14】エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、前記燃料噴射弁の噴射口には、噴射される燃料をエンジンの吸気弁のヘッド上面のうち燃焼室中央寄りの位置或いは吸気弁・シート間の燃焼室中央寄りの位置に導くパイプを接続して成ることを特徴とするエンジンの燃料供給装置。

【請求項15】エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、前記燃料噴射弁が前記吸気通路の絞り弁下流に配置され、前記絞り弁をバイパスして絞り弁上流の空気を前記燃料噴射弁の噴射口周囲から吹き出すバイパス通路を有し、且つ、燃料噴射弁の噴射口にはエンジンの吸気弁に向けたパイプが接続され、このパイプの角度は、噴射された燃料を前記バイパス通路から吹き出される空気と共にエンジンの吸気弁のヘッド上面のうち燃焼室中央寄りの位置或いは吸気弁・シート間の燃焼室中央寄りの位置に導くよう設定して成ることを特徴とするエンジンの燃料供給装置。

【請求項16】請求項15において、前記パイプは二重通路構造として、その内側通路に噴射燃料を通し、外側通路に前記バイパス通路からの空気を通すようにしてあることを特徴とするエンジンの燃料供給装置。

【請求項17】請求項15又は請求項16において、前記エンジンは各シリンダに吸気弁を2個備え、これに対応して前記吸気通路のうちシリンダ近くが二つに分岐され、この分岐通路の一方にエンジンの負荷状態に応じて開閉制御されるSCVが設けられ、前記パイプは、前記分岐通路のうちSCVの無い方に導入されていることを特徴とするエンジンの燃料供給装置。

【請求項18】エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、エンジンの各シリンダが2個の吸気弁を有し、前記吸気通路の絞り弁下流が前記吸気弁に対応して二つに分岐され、且つ、前記燃料噴射弁が前記吸気通路の絞り弁下流に配置され、前記絞り弁をバイパスして絞り弁上流の空気が前記燃料噴射弁の噴射口周囲から吹き出すバイパス通路を有し、燃料噴射弁の噴射口にはエンジンの吸気弁に向けたパイプが接続され、このパイプの出口を、前記吸気通路を分岐する隔壁の上流に該隔壁の端面と近い位置で対向させて成ることを特徴とするエンジンの燃料供給装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、吸気通路に燃料噴射弁を備えたエンジンの燃料供給装置に関する。

【0002】

【従来の技術】従来より広く実用化されている吸気ポート燃料噴射装置（燃料供給装置）では、第8回内燃機関合同シンポジウム講演論文集（'90-1-24, 25, 東京）の177頁～181頁の“ガソリン機関の混合気形成に関する研究”に開示されている如く、燃料噴射弁の噴射燃料は、対向するシリンダ壁面の局所部分に衝突、付着し、徐々に蒸発し、シリンダ内のスワールによって輸送されるものであった。

【0003】また、実開昭61-80365号、実開平1-76560号、実開平2-141678号、実開平2-141679号公報等に開示されるように、燃料噴射弁の噴射孔の周囲に、絞り弁を迂回した補助空気通路を用いて絞り弁上流からの空気を吹き出させて燃料微粒化を図ったものや、特開昭61-16261号、特開昭61-226563号公報に開示されるように、燃料噴射弁の噴射燃料を吸気ポート付近の吸気通路壁に衝突させると共に、吸気ポート壁に絞り弁上流からの空気を吹き出させるスワール通路を設けたり、特開昭59-231133号公報に開示されるように、エンジンの吸気弁近くに絞り弁上流の空気を導くパイプを設けたもの等が知られている。

【0004】

【発明が解決しようする課題】前述したように、従来より種々の燃料供給装置が提案されているが、燃料の大部分は吸気通路壁面や吸気弁に衝突したり、吸気弁のところで曲がる空気流に運ばれてシリンダの燃焼室壁面に衝突するが、このような方式によれば、吸気通路壁面、吸気弁、シリンダ壁面に付着したその一部が蒸発しきれず、液状のまま燃焼室に入りやすい。その結果、気化されない燃料が不完全燃焼されて排気されるので、未燃炭化水素の量が多くなる原因となり、また、燃焼室内に導入される混合気が不均一となって下部に濃いガス層を形成して、燃焼効率を低下させる原因となる。

【0005】そのため、従来は、噴射弁の燃料噴射タイミングを吸気行程前にして、吸気通路壁面、吸気弁等に付着した燃料を熱により気化させているが、これだけでは、液状燃料の気化としては充分ではなく、特に低温始動時には充分ではない。

【0006】このような問題に対処するため、従来はピストンの形状を複雑にし、スキュッシュ効果によって、混合気を乱れを与えて混合気を均一にする方法が上記論文に記載されているが、ピストンの形状が複雑になり、かつ、表面積が増し、熱損失が増大しやすい。

【0007】その他の対策としては、噴射弁の燃料を10ミクロンメータ以下に微細にする必要がある。しかし、気流による燃料の微粒化、超音波による微粒化等は少量の燃料を処理できるだけで、また、壁面、吸気弁等に付着して液膜化される問題を残しているため、充分な効果を上げるまでは至っていない。

【0008】本発明は以上の点に鑑みてなされ、その目的は、上記問題を解消して燃焼室の混同気形成を良好にし、燃焼効率、排気浄化を高めることのできる燃料供給装置を提供することにある。

【0009】

【課題を解決するための手段】本発明は上記目的を達成するために、基本的には次のような課題解決手段を提案する。

【0010】(1) 一つは、エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、少なくとも低負荷運転時に高速空気流を形成する手段を有し、この高速空気流及び前記燃料噴射弁の噴射燃料がエンジンの吸気弁のヘッド上面のうち燃焼室中央寄りの位置或いは吸気弁・シート間の燃焼室中央寄りの位置に集中的に到達するよう設定したものを提案する。

【0011】(2) もう一つは、エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、少なくとも低負荷運転時にエンジンの吸気弁・シート間の気流を縦方向の流れにする縦方向気流形成手段を備えたものを提案する。

【0012】(3) もう一つは、燃料噴射弁の噴射口にパイプを接続して、このパイプにより、噴射燃料をエンジンの吸気弁のヘッド上面のうち燃焼室中央寄りの位置或いは吸気弁・シート間の燃焼室中央寄りの位置に導くものを提案する。

【0013】そのほか、2吸気弁／シリンダ型エンジンについての混合特性をよくするための手段も種々提案するが、これについては、実施例で説明する。

【0014】

【作用】(1) の課題解決手段によれば、低負荷等の部分負荷運転時であっても、高速空気流形成手段を用いて高速の空気流を局部的に発生できる。そして、例えば、吸気行程の前に噴射燃料を吸気弁に衝突させると、その衝突位置となるヘッド上面の燃焼室中央寄りに局部的な液膜が形成される。

【0015】この状態でヘッドの付着燃料は熱で気化し、また気化されない付着燃料は、上記噴射燃料衝突と同位置或いはその近傍の吸気弁・シート間の燃焼室中央寄りの位置を狙った高速の空気流により吹き飛ばされて微粒化すると共に、高速空気流が吸気弁を通過する時のベンチュリ効果により燃料気化が促進される。

【0016】そして、この気化燃料（微粒化燃料を含む）及び高速空気流は、燃焼室の中央寄りに入る所以、シリンダ壁（燃焼室壁）への燃料の再付着を防止すると共に、焼室に発生する渦流により中央から攪拌されてその周りに拡散し燃焼室全体に良好な混合気を形成する。

【0017】また、吸気行程時に燃料を噴射させる場合であっても、吸気弁・シート間のうち燃焼室中央寄りの位置に燃料と高速空気流を通すと、吸気弁が開いた時に吸気弁を通過する高速気流のベンチュリ効果により燃料

が微粒化され、しかも吸気弁、シート間に一部燃料が付着しても、これも高速空気流の吹き飛ばしにより微粒化する。そして、微粒化燃料は、燃焼室中央にストレートに入り、この時に高速空気流により生じる渦流により攪拌されるので、上記同様の作用がなされ、良好な混合気形成を実現する。

【0018】上記の作用は、吸気通路内の空気流速が低速状態にある低負荷運転等の部分負荷運転領域において、強制的に高速空気流を形成して良好な混合気形成を助長するので、特に有効である。高速負荷運転の場合には、吸気通路内の気流が高速状態にあるため、このような高速空気を作る手段の力を借りなくとも良好な混合気形成が可能である。

【0019】なお、低負荷運転時の高速空気流の形成は、例えば、絞り弁の上下流に差圧を利用してバイパス通路等で絞り弁上流の空気を絞り弁下流に導き、そのバイパス通路の出口、空気吹き出し方向等を工夫することで達成される。

【0020】(2) の課題解決手段によれば、従来の吸気弁のスロープに沿った流れ（横方向の流れ）と異なり、吸気弁・シート間の気流が縦方向になり、燃焼室内には小さな縦方向渦流を発生させて、微粒化燃料がこの微小な渦に乗って燃焼室中央から拡散していく。その結果、壁面付着は防止でき燃焼室内に均一な混合気が形成される。

【0021】(3) の課題解決手段によれば、パイプにより燃料が拡散することなく、噴射される燃料をエンジンの吸気弁上面のうち燃焼室中央寄り或いは吸気弁・シート間のうち燃焼室中央寄りの位置に導かれるので、(1) の作用同様に、微粒化燃料を燃焼室の中央に導くことで、シリンダ壁面への燃料の付着を防止でき、良好な混合気形成を図れる。

【0022】

【実施例】本発明の実施例を図面により説明する。

【0023】図1～図4に本発明の第1実施例を示す。

本実施例は、請求項1、2の具体例である。

【0024】エンジン1は通常のガソリンエンジンである。吸気通路22の絞り弁15下流位置で吸気弁の2近くに燃料噴射弁3が配置してある。燃料噴射弁（以下、噴射弁とする）3は例えば、電磁噴射弁が使用される。噴射弁2のノズルボディ4の燃料噴射口4a、4bは吸気弁2のヘッド上面のうち燃焼室10の中央側に向いている。

【0025】ノズルボディ4の周りに空気ノズルボディ6が設けられて、燃料噴射口4a、4bの先端周縁に空気ノズルボディ6の噴口9a、9bが配設してある。

【0026】噴口9a、9bは、吸気通路22の絞り弁15をバイパスさせた通路8の空気吹出口となるもので、バイパス通路8の入口が絞り弁15上流に開設する。

【0027】噴口9a, 9bは例えば2個で、その形状、角度、位置は、噴射弁3から噴射される燃料が空気噴口9a, 9bから吹き出される高速空気流に囲まれて吸気弁2のヘッド上面のうちシリンダ10壁から離れた所（ここでは点火プラグ11に近い燃焼室中央寄り）に集中的に到達するように設定してある。高速空気流は、例えば低負荷運転のような絞り弁上下流の圧力差が大きくなった場合に生じる。

【0028】空気噴口9a, 9bからの噴流は、斜めに衝突して横断面が橿円状の噴流（空気流）が合成され、且つ2個の噴口9a, 9bの孔径を異ならせることで、噴流は破線B方向に偏向し、この中を通る噴射燃料も破線B方向に偏向される。この偏向B方向が環状部（吸気弁2とそのシート間）5のうち燃焼室10中央寄りの位置、すなわち点火プラグ11に近い方となるように、噴口9a, 9bの設計をしておく。

【0029】本実施例では、エンジン1の吸気行程の前に噴射弁3から燃料を噴出させる。

【0030】ノズル4から噴射した燃料は、部分負荷運転時には、噴口9a, 9bからの空気噴流に囲まれて拡散することなくB方向の軌道に乗り、図2に示すように吸気弁2のヘッド上面における点火プラグ11に近い位置に局所的に衝突する。吸気弁2が開くと、図3に示すように噴口9a, 9bからの高速空気流（この時、ノズル4からは燃料が噴射されていない）が環状部5のうち燃焼室中央寄りの位置を通過し、これにより吸気弁2に付着した燃料が吹き飛ばされて微粒化されると共に、負圧で吸引されるいわゆるベンチュリ効果により気化促進されて、燃焼室10中央に入り、点火プラグ11近傍に良好な混合気が形成される。

【0031】本実施例によれば、燃料が拡散することなく吸気管壁、シリンダ壁、ピストン面に燃料が付着するのを回避できる。

【0032】また、吸気弁2を通る空気Eは図3のE1, E2で示すごとく燃料を包むように流入し、燃料はE1の流れに乗って燃焼室中央に導かれ、シリンダ壁面への再付着が防止される。

【0033】さらに、本実施例のもう一つの効果として空気ノズル6の空気により燃焼室10内に微小な乱れをつくることができ、この小さな渦流に微粒化燃料が燃焼室中央から拡散していくので、混合気の均一形成を助長する。

【0034】次に、エンジンの負荷が増大すると吸気管22の圧力が増大し、噴口9a, 9bの噴流Bの速度が低下し、図4のAで示す如く燃料は環状部5に均一に供給されるようになる。このときは、空気ノズル6が高速空気流を形成しなくとも吸気弁2を通る空気のE1, E2の速度が大きくなるので吸入空気によって燃料がDのごとく再微粒化される。

【0035】次に第2実施例を図5、図6により説明す

る。第2実施例は、請求項1, 請求項2, 請求項3の具体例である。

【0036】本実施例はエンジン1の各シリンダ10が2個の吸気弁2, 21を有し、燃料噴射弁3のノズルボディ4が2吸気弁に対応した複数の噴射口4a, 4bを有する方式の燃料供給装置である。

【0037】吸気通路22のうちシリンダ10近くの位置に隔壁22'を設けて各吸気弁2, 21に対応する分岐通路22a, 22bが形成され、この分岐通路の一方22aには、エンジンの負荷に応じて開閉制御されるスワールコントロール弁（以下、SCVと略する）13が設けてある。このSCV13は、高負荷の時に開、低負荷の時に閉となる。

【0038】一方、燃料噴射弁3は絞り弁下流で分岐通路22a, 22bの中間に位置し、また、噴射弁のノズルボディ4の周囲に空気ノズルボディ6を配する。空気ノズルボディ6は、その噴口9, 91が燃料噴射口4a, 4bの先端周囲に位置し、噴口9, 91により、吸気通路22の絞り弁をバイパスさせた空気通路8からの絞り弁上流の空気を噴射する。噴口9, 91は、低負荷運転時に燃料噴射弁3の各噴射口4a, 4bから噴射される燃料を分岐通路のうちSCV13の無い方22bに偏向させる高速空気流（高速空気流は、低負荷運転時のように絞り弁上下流の圧力差が大きくなった場合に生じる）が吹き出すよう設定してある。これは、例えば、噴口9, 91を円形とし、噴口9の径Φ1と91の径Φ2が異なるようにすれば（Φ1>Φ2）、噴口9, 91から出る空気噴流は衝突し、図6のCで示した如き橿円状の噴流が形成され、しかも、上記のように径Φ1, Φ2を異ならせることで、その空気噴流の力に差が生じて図6のBのように偏向し、この中を通る噴射弁ノズル4a, 4bからの噴射燃料も一本化されて上記空気噴流の偏向の影響を受ける。

【0039】そのため、偏向方向Bを図5のCに示すように吸気弁2・シート間の環状部のうち燃焼室10の中央寄りに設定しておけば、燃料噴射弁3の噴射口4a, 4bから噴射される燃料は、低負荷運転時に空気ノズル9, 91から吹き出される高速空気流によりSCV13の無い方の分岐通路22bに偏向されつつその対応の吸気弁2の図5に示すC領域に集中的に案内される。従って、噴射弁3から噴射される燃料は、この空気流に囲まれ拡散することなく、吸気弁2の環状部5の点火プラグ11に近い位置Cに衝突する。そして、吸気弁2が開くと、空気噴流Bによって第1実施例でも述べた作用と同様にしてC位置の付着燃料が再微粒化されて燃焼室10の点火プラグ11近くに供給される。

【0040】さらに、本実施例では、低負荷運転時には、SCV13が閉じることで、シリンダ11内には片側の分岐通路からの空気流により渦流が発生し、このスワールが燃焼室中央に入る微細燃料を全体に拡散させ、

良好な混合気を形成する。

【0041】負荷が増大して高負荷運転になるとSCV13が開く。この場合には、絞り弁の上下流の差圧が小さい状態にあるため、噴口9, 91からの高速空気流が生ぜず、噴射される燃料は、それぞれ別れて分岐通路22a, 22bを通り、各吸気弁21, 22に衝突する。

【0042】この場合には、吸気通路22の空気流速が速いために、燃料は吸気弁2, 21を通る吸入空気によって微粒化される。

【0043】噴射弁3の構造を図6に示す。噴射弁3のノズルボディ4には、燃料噴射口4a, 4bが設けられている。弁31は電磁コイルの電磁力により引き上げられる。噴射弁3はシール23を介して吸気管22に取付けられる。ノズルボディ4の先端に空気ノズルボディ6が取付けられ、その噴口91, 92が設けてある。空気ノズル6には、吸気管22に設けられたバイパス通路8を介して絞り弁上流から空気が導入される。

【0044】本実施例によれば、1シリングにつき2吸気弁仕様のエンジンであっても、第1実施例同様の効果を得る。

【0045】図7は上記第1実施例、第2実施例と比較するため例示した従来の2吸気弁/1シリング仕様のエンジンの燃料供給装置で、噴射弁1から噴射された燃料は、吸気弁2, 21を通りシリング10に入る。そのとき、シリング壁のF1, F2部に燃料が付着する。また、図8は、上記第1, 第2実施例と比較するため例示した1吸気弁/1シリング仕様のエンジンの燃料供給装置で、吸気通路のうちシリング近くの位置に分岐通路が形成され、この分岐通路の一方にSCV13'が設けてある。この場合、部分負荷運転時にSCV13'を閉じて、SCV13'無しの分岐通路に燃料及び吸入空気を導入した場合、噴射弁3から噴射された燃料は、吸気弁2を通り、シリング4のF3部に付着する。

【0046】これらの図7, 図8の燃料供給装置では、壁面付着燃料は、壁から熱をもらって蒸発するが、スワールによって、シリングの中心に移動することではなく、混合気を均一にするためには、強力なスキュッシが必要である。縦スワールを生じさせても、中心部に燃料蒸気が移動するのは困難である。なお、第2実施例でもSCV13を用いているが、この場合には、燃焼室中央に微粒化燃料が集中して入り、これが中央からその周りに拡散されるので、図8のような不具合は生じない。

【0047】すなわち、以上のような問題を解消するには、第1, 第2実施例のように、吸気弁2のヘッド上面のうち燃焼室中央寄りの位置（点火プラグに近い位置）に吸気行程の前に噴射燃料を集め、これを空気ノズルからの高速空気流によるベンチュリ効果により再微粒化すれば達成できる。

【0048】図9(a)に、従来の別のタイプのエンジンの燃料供給装置を示す。

【0049】この従来例において、噴射弁50から吸気通路51に噴射された燃料は、吸気通路52の吸気ポートで曲がる空気流に運ばれるが、空気流はヘッド上面のスロープにそって流れが横方向になってしまい、この空気流に乗る噴射燃料が燃焼室壁面53に衝突して液膜54を形成する。その結果、液膜が不完全燃焼して、排気され、未燃炭化水素の量が多くなる原因となる。この問題は特に、部分負荷運転域に生じる。

【0050】これを防止するためには、図9(b)に示すように、吸気通路51の絞り弁下流に燃料噴射弁50を設けるほかに、エンジンの吸気弁52近くに低負荷運転時に高速空気流を形成する手段、例えば補助空気通路57を配設し（高速空気流の形成手段の具体例については、後述する）、この補助空気通路57の吹出口が、吹き出される補助空気が吸気弁52の通過位置で縦方向の流れとなる吹出角度を設定することで達成される。

【0051】このようにすれば、部分負荷運転時であっても、補助吸気通路57からの高速空気流56に燃料を乗せて燃焼室中央部に混合気を形成することができ、燃料は燃焼室壁面53に衝突することがないので、燃料付着をなくして、燃焼効率を良好にし排気中の未燃炭化水素の量は大幅に低減される。

【0052】図10に図9(b)の原理を実現させるための一例（第3実施例）を示す。本例は、請求項5, 請求項6の具体例である。

【0053】本実施例は、燃料噴射弁60が吸気通路69の絞り弁67下流側に配置され、吸気通路69のうち絞り弁67下流の通路を上下に主空気通路66と補助空気通路63とに分け、下側通路となる主空気通路66に補助弁64が設けてある。補助弁64は、アクチュエータを用いて低負荷運転時に閉じるように制御するか、絞り弁67と連動するようにする。補助空気通路（上側通路）63の吹出口は、吸気弁61のヘッド周縁のうち燃焼室68の中央寄りの位置に向けて空気を吹き出すよう設定する。噴射弁60は、噴射燃料が吸気弁61のヘッドのうち燃焼室中央寄りに噴射されるようにしてある。

【0054】67は絞り弁67をバイパスして絞り弁上流の空気を噴射弁60のノズルに導入して噴射燃料を微粒化させるもので、以下の効果を奏するには、バイパス67がなくともよい。

【0055】上記の構成において、部分負荷運転時には補助弁64が閉じられる。これにより、絞り弁67下流に流れる空気は開口面積を絞った補助空気通路63に導かれるので、空気流速が増大し、高速空気流が形成される。

【0056】噴射弁60から噴射された燃料は、吸気弁61上の燃焼室中央側に衝突する。この噴射された燃料に、ちょうど吸気弁61上で当たるように、補助空気通路63からの空気流62を供給する。補助弁64を閉じた場合、エンジンに吸入される空気は、大部分、補助空

気通路63を流れる。これにより、縦方向の空気流65が燃焼室内に形成される。この渦により混合気は横方向に進むことなく、また、燃料は気流に乗って燃焼室中央側に集中的に供給されるので、壁面への付着は防止できる。

【0057】また補助弁64を閉じているので、燃料66に空気流は当たらず、噴霧方向は曲げられず、吸気弁61上の狙った位置に直進する。

【0058】全開運転時には、補助弁64は開かれ、吸気抵抗無しにエンジンに空気が吸い込まれる。

【0059】図11は、図10の実施例の原理を2吸気弁／シリンド型のエンジンに応用したもの（第4実施例）で、請求項7の具体例である。

【0060】燃料噴射弁73が2吸気弁に対応した複数の燃料噴射口を有し、吸気通路76のうちシリンド近くの位置に吸気弁70、70に対応する分岐通路76a、76bが形成される。

【0061】分岐通路は、それぞれメイン流路76a'（76b'）と補助空気通路（縦方向気流形成手段）76a"（76b"）とに分けてある。メイン流路76a'及び76b'は補助弁71により開閉制御される。ここでも、燃料は絞り弁74をバイパスした空気通路75から供給される空気流で微粒化してあるが、バイパス75の無い方の噴射弁であってもよい。補助弁71は、絞り弁74と連動するようにしてもよいし、低負荷時に開くように吸気管76の負圧により動作するよう負圧ダイアフラムで駆動しても良い。

【0062】図12も図10の応用例（第5実施例）で、請求項8の具体例である。

【0063】本実施例も、エンジンは2吸気弁／シリンド型で、吸気通路84のうちシリンド85近くの位置に各吸気弁80に対応する分岐通路84a、84bが形成され、この分岐通路の一方84bにのみ燃料噴射弁81から燃料が噴射されるようにしてある。図12（b）は横からみた図で、分岐通路84bのシリンド近くが上下に二つに分けられ、この分けた通路のうち下側通路にエンジンの負荷状態に応じて開閉制御される補助弁82が設けられ、上側通路83を縦方向気流形成手段として機能するよう設定してある。

【0064】本実施例では、一方の吸気弁からは燃料と空気の混合気が供給され、もう一方の吸気弁からは空気のみが供給される。このようにすると、燃焼室85内の混合気分布をある部分を濃く、ある部分を薄くすることができ、燃焼室全体では薄い混合気で燃焼させ、リーンバーンモードを得ることができる。

【0065】また、部分負荷運転時に補助弁82を閉じると、空気が上半分の通路83を通り、吸気弁80の燃焼室85中央に縦方向の流れとなって流入し、縦渦を形成する。この渦により、混合気が攪拌され、混合気分布が均一となる。

【0066】図13に第6実施例を示し、請求項9の具体例である。本実施例は、1吸気弁／シリンドの吸気通路107の絞り弁104下流の一部を上下に通路を分けて、その下側通路107bに補助弁103を設け、この補助弁103が閉じた時に上側の通路107bが第5実施例同様の縦方向気流形成手段として機能するようにしてある。105は噴射弁106の先端部に空気を導く燃料微粒化用のバイパスである。

【0067】本実施例によれば、補助弁103を閉じた時に吸気管の上半分の通路107bに空気が流れることで、吸気弁89の燃焼室中央部に縦方向の流れの空気が流入し、燃焼室中央に縦方向の渦流を発生して燃焼室を良く攪拌して良好な混合気を形成する。

【0068】図14に第7実施例を示す。本実施例は請求項10の具体例である。

【0069】本実施例も燃料噴射弁95が吸気通路96の絞り弁91下流側に配置されるが、補助弁は設けていない、補助空気通路90が、絞り弁91をバイパスした形で形成されている。補助空気通路90から導入する絞り弁上流からの空気（補助空気）は、吸気弁94近くに吹き出し、吸気弁94とそのシート間のうち燃料室中央寄りの位置に向けて縦方向の空気流を形成するようにしてある。

【0070】このため、絞り弁91が全開以外の時（部分負荷運転時）には、補助空気通路90を通って空気が流れ、吹き出し孔93からは、高速の空気流が噴出する。この空気流は、吸気弁94の、燃焼室中央側に衝突するように噴射する。このため、燃焼室の中央部には、微小な渦が形成される。この渦により、混合気が攪拌されて、燃焼室の混合気分布が均一になる。

【0071】また、本実施例では、補助空気通路90に、アイドル運転時に閉じるカット弁95を設けてよい。アイドル運転時には、要求空気量が少ないので、補助空気を流すと回転数が増加してしまい燃費が悪くなるためである。

【0072】さらに精度を高めるには、図15の第8実施例に示すように、補助空気通路90に制御弁（電磁弁）124を用いるとよい。125は電磁弁124の制御ユニットである。

【0073】図16に電磁弁124の制御動作のタイムチャートの一例を示す。（イ）はある気筒の吸気の状態を示している。この吸気状態の時に、（ロ）のように電磁弁124を開けて補助空気を供給し、燃焼室内に微小な渦流を形成する。吸気行程以外の時に補助空気を流していると、吸気弁近くに残った燃料が、吸気管の上流に吹き上がるため、上記のような電磁弁制御を行えばこれを防止できる。

【0074】またアイドル運転時などは、吸気量が多くなり、回転数が増加してしまう。

【0075】（ハ）は、別の気筒の吸気行程を示してい

る。これに対応して、(二)のように電磁弁124を動作させる。

【0076】図17に、第8実施例の変形例(第9実施例)を示す。図16の電磁弁124の代わりに分配器126を設けた。分配器126は、補助空気を各気筒に対応した通路127a, 127b, 127c, 127dに供給する。供給するタイミングは、各気筒が吸気行程の時に空気が流れるように分配器126を構成する。

【0077】この分配器126は、回転式で、128がその駆動源で、例えばエンジンのクランクで駆動しても良いし、エンジンの回転に同期して回転するモータでも良い。このような構成でも第8実施例同様の動作が可能である。

【0078】また、上記第8実施例の電磁弁に代えて、連続制御が可能な電磁弁を用いてアイドル回転制御ユニットにより補助空気通路を開度制御してもよい。

【0079】図18は本発明の第10実施例で、請求項12の具体例である。

【0080】本実施例は、エンジンの各シリンダが2個の吸気弁109a, 109bを有し、吸気通路107の絞り弁下流が吸気弁に対応して二つに分岐され、この分岐通路の一方107aにエンジンの負荷運転状態に応じて開閉制御される補助弁108が設けてある。補助弁108は部分負荷運転時に閉じ、全開負荷運転時に開く。

【0081】燃料噴射弁110は、図18(a)に示すように、補助弁108が開いている時には、分岐通路107a, 107bの双方に向けて均等に燃料を噴射し、補助弁無108が閉じる時には、図18(b)に示すように、補助弁無しの通路107bに燃料を偏向して噴射するように設定してある。

【0082】図19に、図18の噴射弁先端の構成を示した。図19(a)は、補助弁を閉じている時に、燃料を一方の吸気弁に供給している状態である。113は、例えば絞り弁上流から空気を導くバイパス通路の吹き出し通路で、この通路113から噴出する高速空気流を、計量オリフィス112からの噴射直後の燃料に当てることで燃料の軌道を偏向させている。この偏向角度は、図18の通路107aである。

【0083】図19(b)は、空気通路113からの空気流を止めた状態を示している。燃料は曲がることなくまっすぐに噴出する。これは、図18の補助弁107が開いた時に行われる。

【0084】本実施例によれば、補助弁107を閉じた時には、吸気を一方の通路107aからのみ供給し、燃焼室内に大きな渦を形成して、空気と燃料の攪拌を促進させ、混合気形成を良好にする。補助弁107が閉じている時には、これに噴射燃料が付着するのを防止する。

【0085】図20は第11実施例の部分断面図及びその上面図、図21は本実施例を別の方からみた図で、請求項13の具体例である。

【0086】本実施例は、エンジンが2吸気弁/シリングダ型で、吸気通路96の絞り弁99下流が吸気弁100a, 100bに対応して二つに分岐してある。バイパス通路96aは、吸気通路96の絞り弁99上流から補助空気を取り入れ、絞り弁下流に吹き出す。バイパス通路96aの空気吹出口96a'を、分岐通路近くの上流位置で分岐通路の仕切壁97の一端面に対向させてある。また、隔壁97及び空気吹出口96a'の延長線上で空気吹出口96a'のすぐ近くの上流に燃料噴射弁98が配置してある。

【0087】バイパス通路96aから供給される空気流は、隔壁97の端面に衝突するように噴出する。このようにすると、燃焼室中央部に微小な渦が形成される。噴射弁98から噴出した燃料は、この渦にのって拡散しながら燃焼室に分散してゆき、燃焼室内の混合気分布が均一になる。この場合、燃料は、吸気弁100a, 100bの外側101にはあまり噴射しないようにした方が良い(外側に燃料を供給すると、燃焼室の壁に燃料が飛散してゆき、付着燃料が発生するためである。)これは噴射弁98の噴霧の方向性で達成することができる。

【0088】図22(a)は第12実施例を示し、請求項14の具体例である。

【0089】本実施例は、燃料噴射弁115の噴射口にパイプ116を接続し、パイプ116を介して、噴射される燃料をエンジンの吸気弁117とそのシート間のうち燃焼室中央寄りの位置に導くようにした。このようにすると、噴射燃料が、吸気管118の気流に流されずに直進し、狙った位置に到達する。

【0090】本実施例においても、噴射燃料が燃焼室壁に付着するのを防止できる。

【0091】図22(b)は第12実施例の変形例(第13実施例)で、請求項15の具体例である。燃料噴射弁122が絞り弁121下流に配置され、絞り弁121をバイパスする通路120から導入される絞り弁上流の空気が燃料噴射弁121の噴射口周囲から吹き出す。燃料噴射弁122の噴射口にはエンジンの吸気弁に向けたパイプ119が接続され、パイプ119の角度は、噴射された燃料をバイパス通路120から吹き出される空気と共にエンジンの吸気弁117・シート間のうち燃焼室中央寄りの位置に導くよう設定してある。

【0092】本実施例によれば、第12実施例同様の効果を奏するほかに、吸気行程時に燃料噴射を行った場合でも、バイパス通路120及びパイプ119を介して吹き出される空気流によって、燃焼室内に微小な渦65が形成され、この空気流により噴射弁122から噴射される燃料が微粒化され、混合気形成をより一層良好にし、しかも、吸気行程時の燃料供給により燃料制御の応答性を向上させることができる。

【0093】図23は第13実施例の変形例(第14実施例)で、第13実施例と異なる点は、燃料噴射行程を

吸気行程前としたものである。

【0094】本実施例によれば、パイプ119を介して吸気弁117に衝突した噴射燃料は、パイプ119を介して吹き出される空気流により吸気弁117で微粒化される。この場合も、燃料は吸気弁上の燃焼室中央寄りにパイプ119を開口する。

【0095】図24は上記パイプ119と噴射弁122との接続構造を示す一例で、バイパス通路120からの空気は噴射弁122の下部に設けたチャンバ123に供給される。ここから、孔124を通ってパイプ119内に供給される。パイプ119内では、噴射燃料が空気に入包まれるようにして、パイプ内壁に衝突することなくパイプの端部125から吹き出される。

【0096】図25は上記パイプ119の他の例で、パイプ119二重通路構造として、その内側通路119bに噴射燃料を通し、外側通路119aにバイパス通路120からの空気を通すようにしてある。

【0097】パイプ119の内側通路119bは、連通路127を介して吸気管118の圧力と同レベルにしている。外側通路119aから開口119a'を介して吹き出される空気は燃料126と衝突し微粒化される。連通路127がない場合には、パイプ内119bは、噴射燃料により負圧になり、燃料が広がりパイプ内壁に付着する。連通路127を設けると、吸気管内118の圧力とパイプ内119bの圧力が等しくなって、燃料の広がり防止ひいては燃料付着防止を図れる。

【0098】図26は本発明の第15実施例で、第12～第14実施例の変形例で請求項17、請求項18の具体例である。

【0099】本実施例は、2吸気弁／シリンド型のエンジンに適用したもので、吸気弁117aに対応する分岐通路の一方118aにエンジンの負荷状態に応じて開閉制御されるSCV108が設けられ、パイプ119は、分岐通路のうちSCVの無い方118bに導入されている。パイプ119は、一方の吸気弁117bのみに燃料を供給し、吸気弁117bの燃焼室中央寄りの位置に供給するようにしてある。

【0100】このようにすると、燃料は、燃焼室中心に分布するようになり、点火プラグ131の着火性が向上する。また、分岐通路118aの吸気ポートをSCV108で閉じると、燃焼室内にスワールが形成され、混合気の形成、燃焼が促進される。

【0101】図27は第15実施例の変形例（第16実施例）でパイプ119は吸気弁117bのヘッド中心に燃料が供給されるように開口されている。このようにしても、燃焼室の中心に混合気を分布させることができる。

【0102】図28は、二重構造パイプ119の変形例で、パイプ119の端部にくさび型部材135を設けて、噴射燃料がここに衝突するように設定する。さら

に、くさび型部材135に外側通路119aから噴射された空気が当たるように、燃料の微粒化を図っている。図29に図28のパイプ119を用いた実施例（第17実施例）を示した。燃料はくさび部材135により二方向に分割されて、各吸気弁117a、117bに分配される。

【0103】図30に二重構造パイプ119の他の例を示す。パイプ119の外側通路119aを通った空気は、端部119a'から吹き出される時に、吸気弁117上か、吸気弁117・シート136の隙間で衝突するように、空気吹出口119a'の方向を決める。このようにすると、燃料は、直接燃焼室内に流入することができ、パイプ119から噴出する空気は燃料の微粒化に用いられるばかりでなく、燃焼室内に微小な乱流137を形成して、燃料の混合を促進する。さらに、この乱流により燃焼が促進される。

【0104】

【発明の効果】以上のように本発明によれば、燃焼室壁面への燃料付着を防止しつつ微粒化燃料を燃焼室に供給できるので、燃焼室の混合気形成を良好にし、燃焼効率、排気浄化を高めることができる。

【図面の簡単な説明】

【図1】本発明の第1実施例を示す構成図

【図2】第1実施例の燃料噴射後の吸気弁の燃料付着状態を示す説明図

【図3】第1実施例の動作を示す説明図

【図4】第1実施例の動作を示す説明図

【図5】本発明の第2実施例を示す説明図

【図6】第2実施例に用いる噴射弁のノズル部を示す断面図

【図7】従来例の問題点を示した説明図

【図8】従来例の問題点を示した説明図

【図9】(a)は従来例の問題点を示す説明図、(b)は本発明の原理を示す説明図

【図10】本発明の第3実施例を示す説明図

【図11】本発明の第4実施例を示す説明図

【図12】本発明の第5実施例を示す説明図

【図13】本発明の第6実施例を示す説明図

【図14】本発明の第7実施例を示す説明図

【図15】本発明の第8実施例を示す説明図

【図16】第8実施例の動作状態を示すタイムチャート

【図17】本発明の第9実施例を示す説明図

【図18】本発明の第10実施例を示す説明図

【図19】第10実施例に用いる噴射弁のノズル部を示す説明図

【図20】本発明の第11実施例を示す説明図

【図21】第11実施例の別の角度からみた図

【図22】(a)は本発明の第12実施例、(b)は第13実施例を示す説明図

【図23】本発明の第14実施例を示す説明図

【図24】第13, 第14実施例に用いる噴射弁及びパイプの一例を示す説明図

【図25】上記パイプの他の例を示す説明図

【図26】本発明の第15実施例を示す説明図

【図27】本発明の第16実施例を示す説明図

【図28】上記パイプの他の例を示す説明図

【図29】本発明の第17実施例を示す説明図

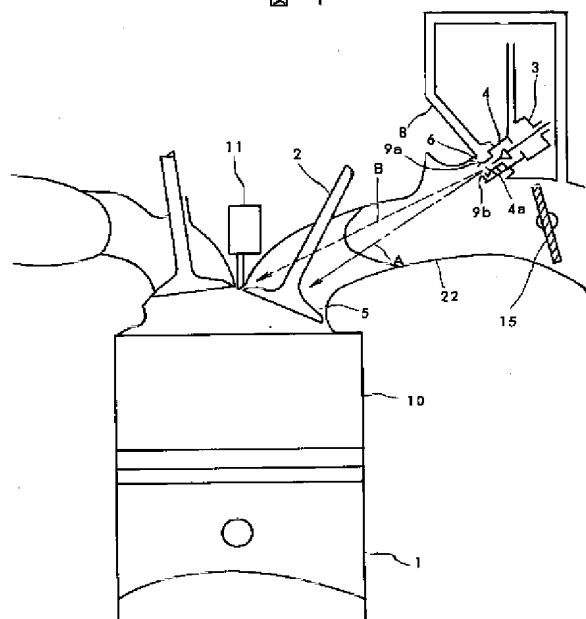
【図30】上記パイプの他の例を示す説明図

【符号の説明】

1…エンジン、2, 21…吸気弁、3…噴射弁、4…噴射ノズルボディ、4a…燃料噴射口、5…吸気弁・シート間（環状部）、6…空気ノズルボディ、8…バイパス通路（高速空気流形成手段）、9a, 9b…空気吹出口、9, 91…空気吹出口、10…燃焼室、11…点火プラグ、13…SCV、15…絞り弁、22…仕切壁、22a, 22b…分岐通路、57…バイパス通路（縦方向気流形成手段）、119…パイプ。

【図1】

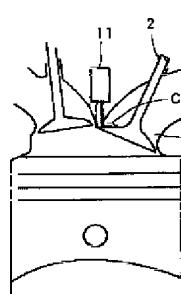
図 1



1…エンジン
2…吸気弁
3…噴射弁
4…噴射ノズルボディ
4a…燃料噴射口
5…吸気弁・シート間（環状部）
6…空気ノズルボディ
8…バイパス通路（高速空気流形成手段）
9a, 9b…空気吹出口
10…燃焼室
11…点火プラグ
15…絞り弁

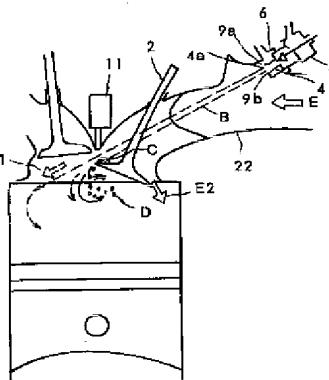
【図2】

図 2



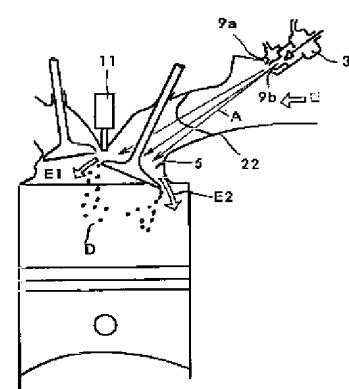
【図3】

図 3



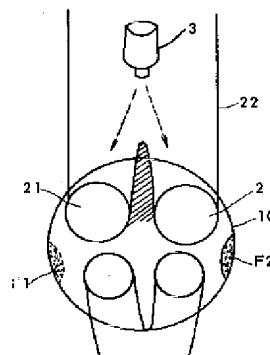
【図4】

図 4



【図7】

図 7

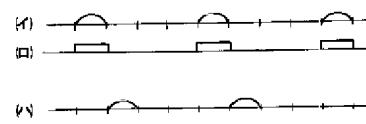
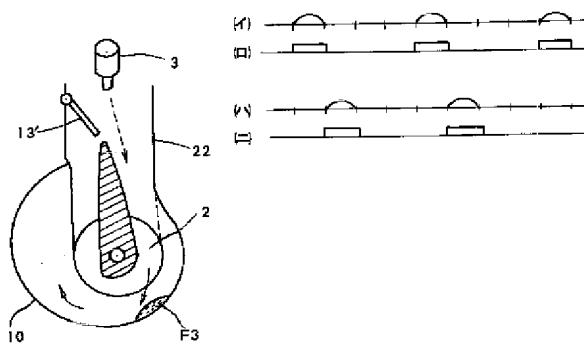


【図8】

【図16】

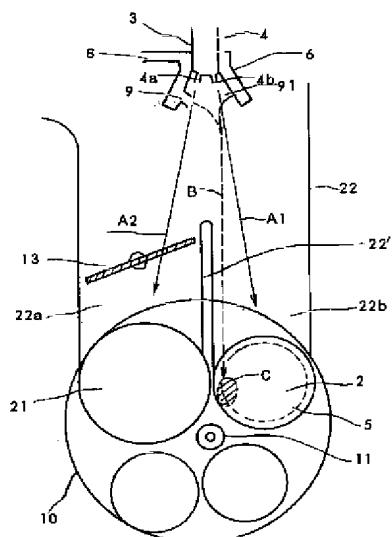
図 8

図 16



【図5】

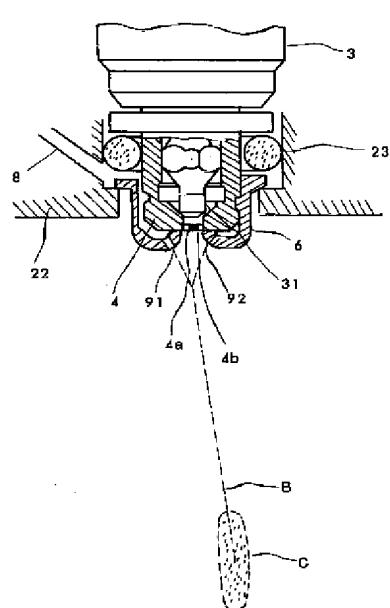
図 5



4a, 4b ... 空気吹出口
13 ... SCV
22' ... 隔離
22a, 22b ... 分岐通路

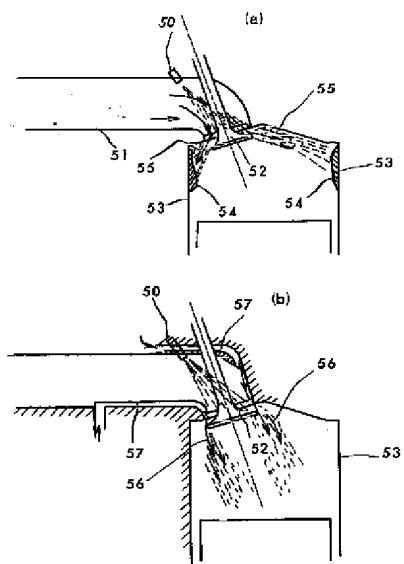
【図6】

図 6



【図9】

図 9



57 ... バイパス通路 (横方向気流形成手段)

【図11】

【図10】

図 10

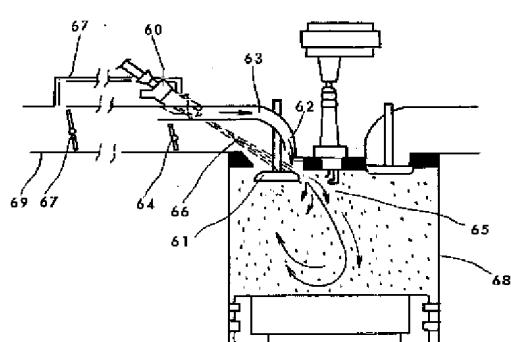
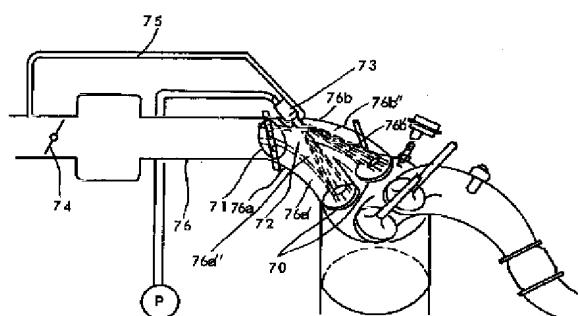
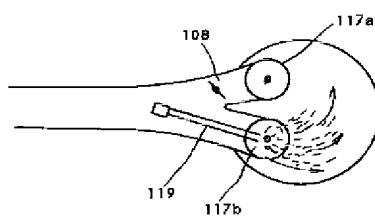


図 11



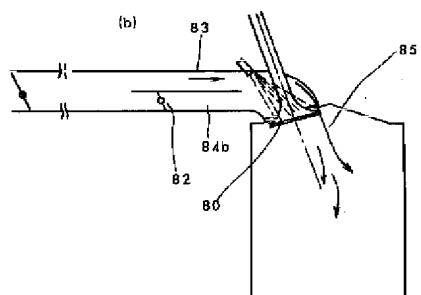
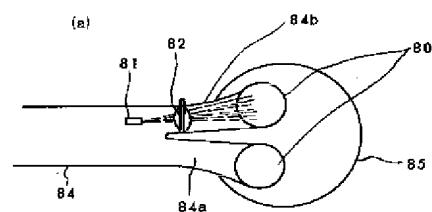
【図27】

図 27



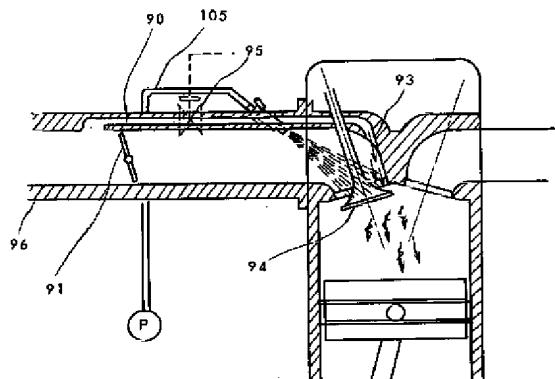
【図12】

図 12



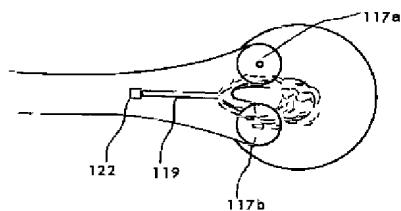
【図14】

図 14



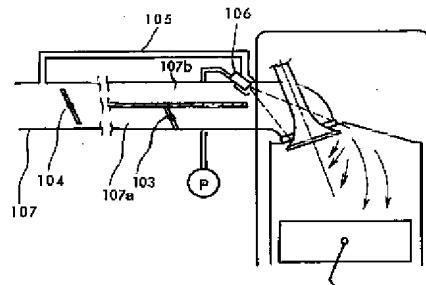
【図29】

図 29



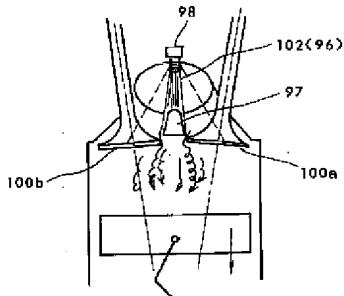
【図13】

図 13



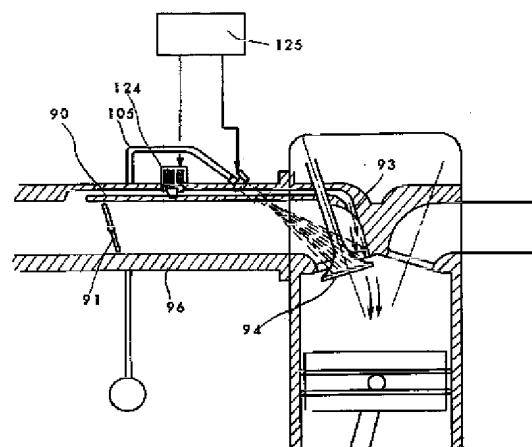
【図15】

図 15



【図21】

図 21

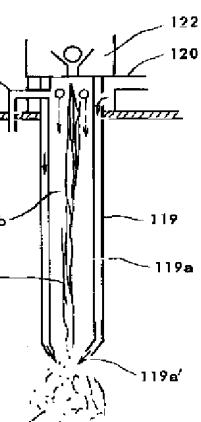
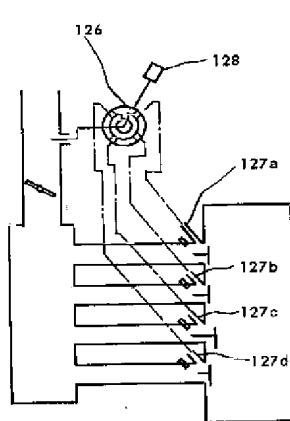


【図17】

図 17

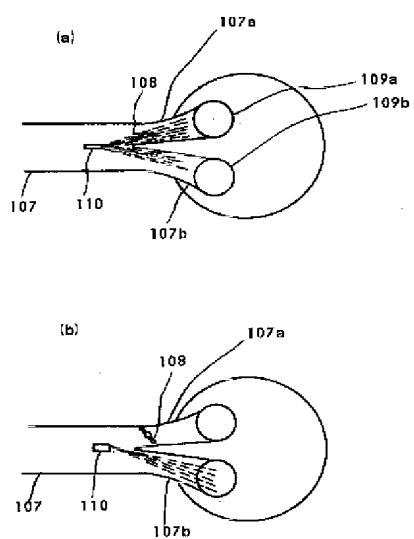
【図25】

図 25



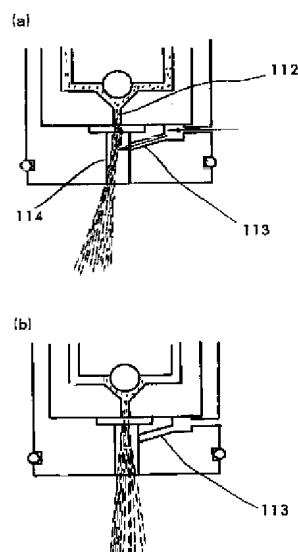
【図18】

図 18



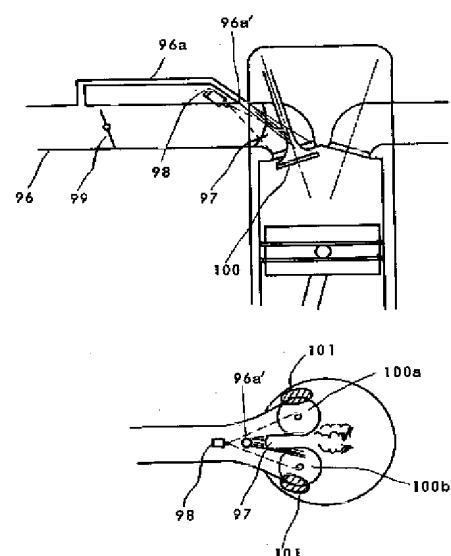
【図19】

図 19



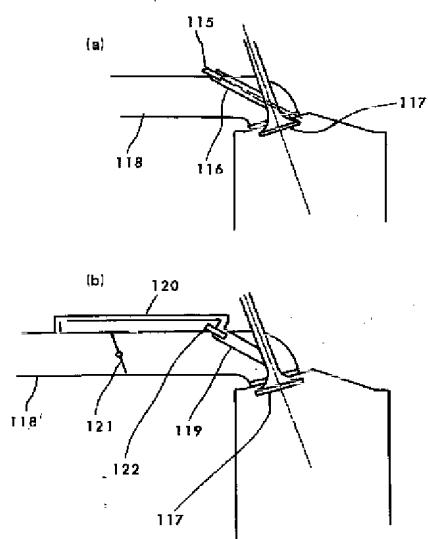
【図20】

図 20



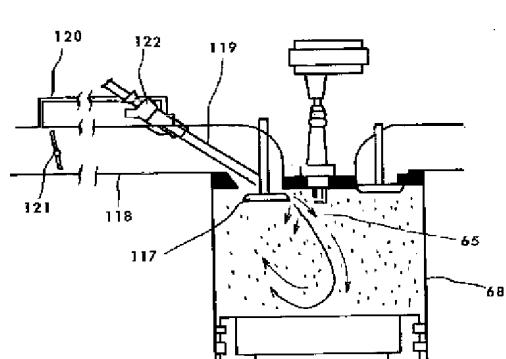
【図22】

図 22



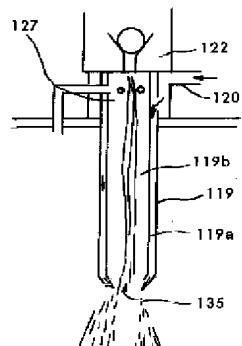
【図23】

図 23



【図28】

図 28

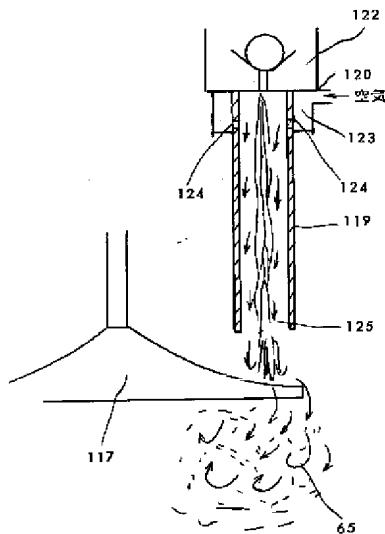


115…燃料噴射弁
117…吸気弁
119…パイプ

117…吸気弁
119…パイプ
122…燃料噴射弁

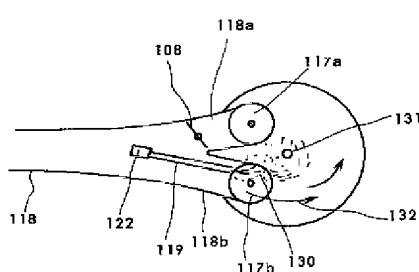
【図24】

図 24



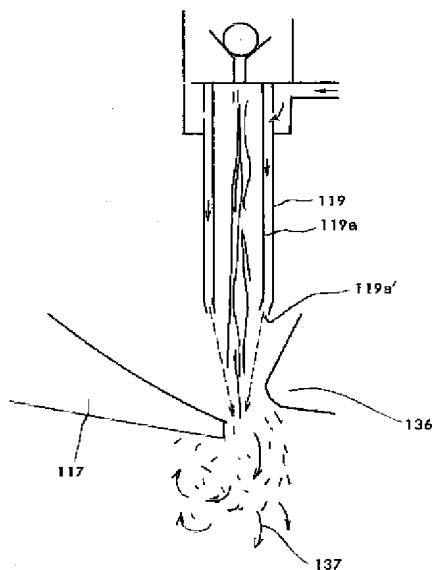
【図26】

図 26



【図30】

図 30



【手続補正書】

【提出日】平成14年6月12日(2002.6.12)

【手続補正1】

【補正対象書類名】明細書

【補正対象項目名】特許請求の範囲

【補正方法】変更

【補正内容】

【特許請求の範囲】

【請求項1】 エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、前記吸気通路の絞り弁と吸気ポートとの間の通路部を上下に分けて、そのうちの下側の通路に補助弁を設け、前記燃料噴射弁は、前記吸気通路の上部に取付けられてエンジンシリンダの吸気弁に向けて燃料噴射するように設けられ、この燃料噴射弁の噴射口の周りに前記絞り弁をバイパスして絞り弁上流の空気を導く構成としたことを特徴とする燃料供給装置。

【請求項2】 前記上下に分けた吸気通路のうち上側の通路の吹出口は、前記吸気弁のヘッド周縁のうち前記エンジンシリンダの中央寄りの位置に向けて空気を吹き出すよう設定され、前記燃料噴射弁は、噴射燃料が前記吸気弁のヘッドのうち燃焼室中央寄りに噴射されるようにしてあり、前記補助弁は、低負荷運転時に閉じるように制御するか、絞り弁と連動するようにしてある請求項1記載の燃料供給装置。

【手続補正2】

【補正対象書類名】明細書

【補正対象項目名】0012

【補正方法】変更

【補正内容】

【0012】さらに、上記(1)(2)の好ましい態様として、エンジンの吸気通路に燃料噴射弁を備えた燃料供給装置において、前記吸気通路の絞り弁と吸気ポートとの間の通路部を上下に分けて、そのうちの下側の通路に補助弁を設け、前記燃料噴射弁は、前記吸気通路の上部に取付けられてエンジンシリンダの吸気弁に向けて燃料噴射するように設けられ、この燃料噴射弁の噴射口の周りに前記絞り弁をバイパスして絞り弁上流の空気を導く構成としたものを提案する。また、前記上下に分けた吸気通路のうち上側の通路の吹出口は、前記吸気弁のヘッド周縁のうち前記エンジンシリンダの中央寄りの位置に向けて空気を吹き出すよう設定され、前記燃料噴射弁は、噴射燃料が前記吸気弁のヘッドのうち燃焼室中央寄りに噴射されるようにしてあり、前記補助弁は、低負荷運転時に閉じるように制御するか、絞り弁と連動するようにしたものを提案する。

【手続補正3】

【補正対象書類名】明細書

【補正対象項目名】0021

【補正方法】削除

フロントページの続き

(51) Int.Cl. ⁷	識別記号	F I	(参考)
F 0 2 D 9/02	3 6 1	F 0 2 D 9/02	T
F 0 2 F 1/42		F 0 2 F 1/42	3 6 1 C
F 0 2 M 51/02		F 0 2 M 69/00	F
69/00			3 1 0 C
	3 1 0		3 6 0 B
	3 6 0	51/02	3 6 0 C
		69/00	H
			3 5 0 A
			3 5 0 W
(72)発明者 野木 利治		F ター△(参考)	3G024 AA09 AA10 BA00 DA01 DA06
茨城県日立市久慈町4026番地 株式会社日			DA08
立製作所日立研究所内			3G065 AA07 AA11 CA12 HA02
(72)発明者 山口 純一			3G066 AA01 AB02 BA03 BA17 BA23
茨城県日立市久慈町4026番地 株式会社日			BA65 CE22
立製作所日立研究所内			